

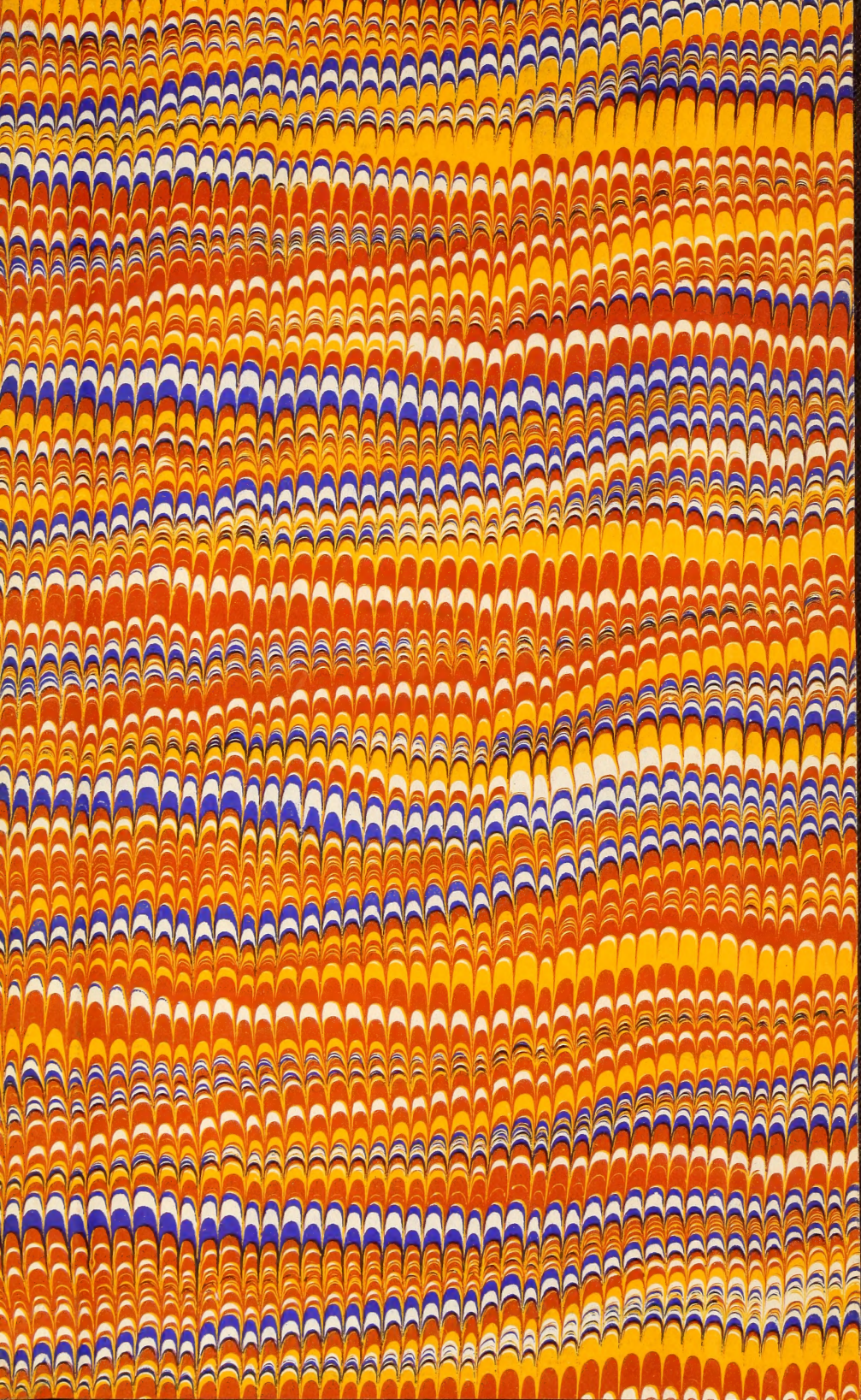




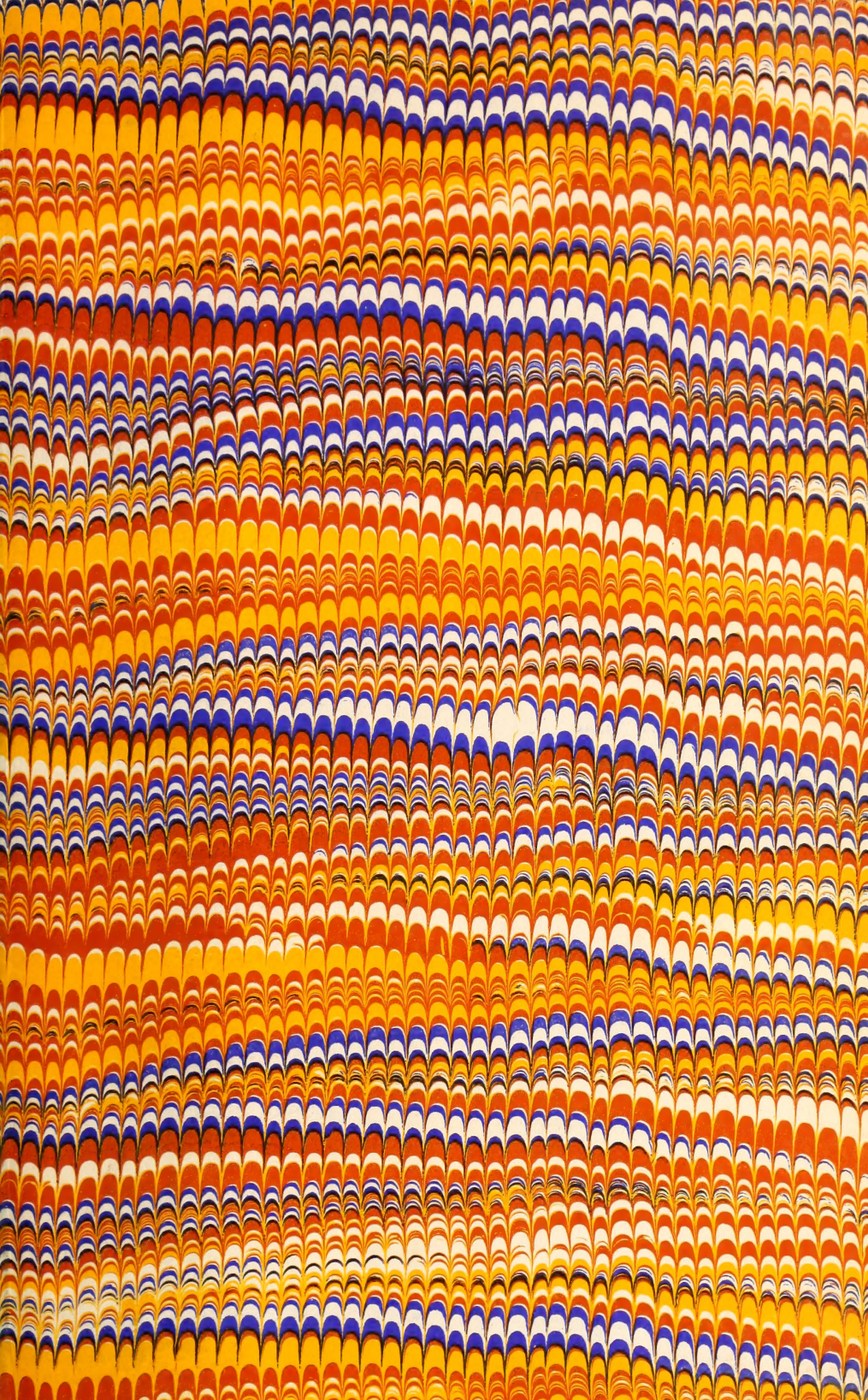


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REPORT *of* THE  
SECRETARY OF  
AGRICULTURE  
1935

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# REPORT *of* THE SECRETARY OF AGRICULTURE

1935



UNITED STATES  
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## REPORT OF THE

## SECRETARY OF AGRICULTURE, 1935

WASHINGTON, D. C., *December 10, 1935.*

To the PRESIDENT:

## FARM RECOVERY AIDING GENERAL RECOVERY

It is evident from the language of the Agricultural Adjustment Act that Congress intended the legislation to benefit our economy as a whole, and to invigorate urban industry as well as agriculture. The purpose of the act, in short, is to promote a balanced abundance. It stipulates that the interests of consumers shall be protected and that cordial relations shall be established between town and country. Those who drafted the legislation did not conceive that relief to agriculture would mean damage to other legitimate interests or that the removal of one injustice would create another. They projected a farm program calculated to harmonize farm welfare with general welfare.

The Agricultural Adjustment Administration programs have definitely advanced us toward this goal. Their primary aim has been to allow for the decline in agriculture's foreign market. That has been accomplished. Last year's drought reduced the production of feed, livestock, and dairy products more than was desirable, but the Agricultural Adjustment Administration took steps at once to mitigate the consequences of the drought to consumers as well as to producers. It modified the farm-contract requirements so as to step up production in the lines in which the drought had cut it down too much. As the framers of the law expected, the partial restoration of farm incomes has stimulated rural buying and consequently helped urban industry.

In working toward these ends agriculture has not sought to create domestic shortages. There is a shortage of hogs just now, but action is going forward to correct it. Throughout the depression farmers have supplied the country with an even flow of goods for processing and domestic consumption. From 1931 up to the present time the volume of manufacturing output processed in the United States from domestic raw materials has remained at approximately 90 percent of the 1929 level. Even this moderate reduction, moreover, is not the result of the farm programs. It is attributable mainly to the failure of the textile industries to consume their normal volume of fibers. The cotton supply available is more than ample.

For the current crop year the supply of most food crops is fully adequate, certain classes of wheat being the only exception. There are rather large crops of rye, beans, potatoes, sweetpotatoes, and

sugar beets. Potato production is about average; the production of buckwheat and rice, though below normal, is sufficient; we have average fruit crops rather evenly distributed, except that citrus production is light in the Gulf States; the production of vegetables for canning is close to or above previous records, and supplies of market vegetables and truck crops are moderately heavy in some areas and excessive in others. Dairy production this year was substantially greater than in 1934. Normal growing conditions in 1936 may confront agriculture once more with the problem of surpluses.

### **No Injustice to Consumers**

Consumers have suffered no injury from the farm programs, as may be judged from the farm-commodity price level. Farm commodities in August 1935 averaged only 6 percent above the pre-war level, whereas the prices of the things that farmers usually buy were 26 percent above pre-war prices. In considering the recent sharp advance in consumers' prices it is necessary to bear in mind the low point to which agricultural prices had previously declined. Fair returns to farmers do not involve unfair prices to consumers. Food prices in the spring of 1933 averaged only 60 percent of what they were in 1928. They are still only about 80 percent of the 1928 level. The average employed factory worker's earnings have also risen to about 80 percent of the 1928 level. Consumers can buy their usual quantities of farm products for one-fifth less money now than they could in 1928. Those who are unemployed find it difficult to pay their living costs; but the remedy for that situation is to increase industrial employment, not to hold farm commodity prices below the fair exchange value.

Moreover, farmers do not and cannot monopolize the benefits of farm recovery. The fact that industrial pay rolls and average earnings per employed factory worker have increased since 1933 in about the same proportion that farm incomes have increased is evidence that farm recovery promotes industrial recovery. It appears that about 4 out of every 10 persons reemployed in urban industry since the spring of 1933 owe the recovery of their jobs to the improvement in the farm situation. Statistical evidence compiled by this Department indicates that shipments of industrial goods to rural areas have increased proportionately with the advance in rural incomes. Farm recovery got under way in 1933 earlier than industrial recovery, and maintained its lead in 1934. Urban industry benefited promptly. For example, in towns of less than 10,000 population and on farms sales of automobiles in 1934 totaled 833,000, as compared with 602,000 in 1933. This was an increase of 231,000, or 38 percent. In cities of more than 10,000 population, on the other hand, sales of automobiles in 1934 were 1,055,000, as against 892,000 in 1933, an increase of 163,000, or only 18 percent.

### **Toward a Balanced Abundance**

Continued farm recovery under the Agricultural Adjustment Act should carry us further toward the ideal of a balanced abundance and should promote a fuller utilization of our human and material resources. Recovery from last year's drought is under way. As



consumer-buying power increases with revived industrial activity and lays a foundation for a higher national standard of living, the crop programs will provide for increased production for domestic consumption. Farm incomes will increase because farmers will have more to sell at a fair price, and consumption per capita will be higher. Manifestly, however, the task of establishing a balanced abundance is not the sole responsibility of the farmers; indeed, it is not even mainly their responsibility.

Agriculture is not the laggard in production. In August 1935 factory employment in this country was nearly one-fourth lower than it was in 1928, and about one-fourth of the urban population that should have been employed was not. But most of the factory unemployment was in the factories processing industrial, not farm products. Factories processing farm products employed in 1934 about 82 percent as many wage earners as they did in 1929, whereas the factories processing nonagricultural raw materials employed 30 percent less labor than in 1929. Most of our agricultural, industrial, and fiscal difficulties would be solved if the manufacturing branches of industry were operating as freely as the agricultural. From the standpoint of domestic requirements, agriculture, in contrast with industry, has maintained its output.

In a truly balanced economy industrial production would outstrip farm production, for it should be remembered that a price disparity prevailed against agriculture even in the predepression years. This means, of course, that agricultural production was then relatively greater than industrial production. With agriculture continuing to supply the domestic market abundantly, as it fully intends to do, parity prices for agriculture would require an industrial production level at least 10 percent higher than that of 1929.

On a per capita basis the United States has recovered half the depression loss in the physical production of consumers' goods, and one-third of the depression loss in the physical production of capital goods. In August 1935 the per capita production of goods for sale to consumers (including automobiles) was 84 percent of the 1929 level, as compared with 72 percent in 1932. Our production of capital goods in August 1935 was 53 percent of the 1929 level, as compared with 27 percent in 1932. Though they reduced the farm output, the Agricultural Adjustment Administration programs contributed to the total gain. This apparent contradiction is the result, of course, of the stimulus that farm recovery imparted to nonfarm industries and to the fact that Agricultural Adjustment Administration's efforts were directed at restricting production not of goods for domestic consumption but of goods for which a satisfactory foreign market no longer existed. When farmers stopped producing for vanished export markets, farm-cash income increased, the country demand for city goods revived, and urban employment mounted. Nevertheless, industrial production in 1935 was still only 74 percent of what it was in 1929, whereas farm production was 88 percent of the 1929 level. This disparity is the more striking when we reflect that agriculture through the decline in foreign trade has suffered much more than industry from a shrinkage in its total market. Relative to the demand, agriculture is producing far more abundantly than urban industry.

### Other Essentials to Recovery

That full industrial recovery will require some additional stimulus is evident. Our population is now 5 percent larger than it was in 1929. Had the production trend of the predepression period (with production growing faster than population) been maintained, the physical output for 1935 would be considerably greater than that of 1929. Actually, as already noted, it will be about 25 percent less. Yet even in 1929 our actual production was far below our production capacity, just as our real consumption was below our consumption needs. Federal action taken to protect consumers, to provide economic security, and to redistribute tax burdens, should help toward continued expansion in both production and consumption. These policies tend to increase the proportion of the national income going to persons in the lower income brackets, and therefore to increase consumption per capita. Other national policies, such as those implemented in Public Works Administration, Works Progress Administration, Home Owner's Loan Corporation, Federal Housing Administration, and Farm Credit Administration should help. All these constructive influences combined, however, may fail to revive industrial production sufficiently in the absence of a coordinated effort for general expansion.

As is well known, our efforts up to the present to coordinate recovery have dealt separately with separate industries. The Agricultural Adjustment Act has dealt with agriculture, the Guffey law with coal, the National Recovery Act with different branches of industry each under its own separate code. The proposed Ellenbogen bill for textiles goes on the same principle. Such measures, each dealing with an individual industry, in seeking to raise the income of that industry, must depend in the last resort on restriction of output to what the market will take at the prevailing level of purchasing power. Should one industry attempt, independently of the others, to run at capacity it would not find an increased market. But were all the major industries to expand together, the total market would grow with the total production; buying power and production would expand together. Partial coordination, undertaken from the standpoint of individual industries, must give place to a general, comprehensive coordination aimed at increased production and increased pay rolls, if we are to have full employment, full production, and higher living standards. How to achieve coordination for balanced expansion is the problem which awaits solution.

### PERMANENT AGRICULTURAL ADJUSTMENT

Almost everyone recognizes that American farmers had perforce to act in concert under Federal guidance to meet the situation that developed after the crisis of 1929. With foreign markets blocked and domestic buying power low, huge supplies of the main farm products had piled up in storage. The prices of these products had fallen to a point far below the pre-war level, though the prices of things bought by farmers were still about 24 percent higher than before the World War. This enormous disparity between the prices received and the prices paid by farmers threatened them with whole-



sale bankruptcy. Thousands could not pay their debts or taxes, keep up their farms, or properly shelter, feed, and clothe their families. It was imperative to scale down the farm output in accordance with the reduced foreign demand and to organize the retreat from overproduction so as to prevent it from becoming a rout. Drastic action was necessary at once. Accordingly, farmers generally, and also the Nation as a whole, approved the crop-adjustment programs, which under the Agricultural Adjustment Act brought supplies into a better relationship with the shrunken market.

In the 2½ years that have elapsed since the passage of the Agricultural Adjustment Act the farm surpluses have largely disappeared. Cotton is still present in quantities much above immediate requirements but supplies of grains and livestock products are no longer excessive. Stocks of certain types of tobacco are still large. Dairy supplies are more nearly in line with the effective demand. Between 1932 and 1934 the production of 12 important crops declined more than one-third, and farm commodity prices rose. For the calendar year 1932 the prices of farm products averaged only 65 percent of the pre-war level. In March 1935 they averaged 108 percent of the pre-war level. These changes in production and prices, however, were only partly the result of the Agricultural Adjustment Administration adjustments and for many commodities were excessive. The drought of 1934 was very largely the cause. It would be wrong to conclude, therefore, that the need for crop adjustment had disappeared. On the contrary, it continued. Latent tendencies toward overproduction were still in evidence, which would become active immediately if foreign demand should remain stagnant and weather return to normal.

### Shortcomings of the Emergency Methods

Certain shortcomings developed in the emergency adjustments which should be remedied in planning production control on a more permanent basis. In the drive for quick results, the effect on individual farmers could not always be carefully considered. Emergency adjustment contracts, as a matter of convenience, had to be based on the past production of individual farmers. That tended to make past production a sort of property right, to perpetuate maladjustments among farmers and regions, and to prevent desirable adjustments to changing economic, physical, and climatic conditions. Farmers made flat percentage cuts from their historic production base. Such flat-percentage adjustments tended to give the highest base to farmers who had responded slowly to the changed market conditions after 1929 and to penalize farmers who had responded more promptly to the reduced demand. Moreover, the emergency adjustments tended to freeze farm production in the historic mold, in violation of efficient practice. Many farmers, though approving of the adjustment program as a whole, were dissatisfied with some of the details.

In the second adjustment season the Agricultural Adjustment Administration modified its regulations to eliminate hardships that would have resulted otherwise, gave farmers more freedom in combining their various crop enterprises in harmony with the crop-

adjustment programs, and began to make the adjustment procedure more flexible. Essentially, however, it retained the commodity approach, pending closer study of the problems involved in adapting the crop adjustment as a whole to the special conditions of various regions, localities, and individual farmers. In long-time adjustments it seems desirable to develop a regional basis, so as to avoid conflict between adjustment quotas and the principles of good land use, balanced farming, and sound farm management. Otherwise it will be difficult to combine the fair treatment of individual farmers with necessary changes in the localization and production of crops.

Analysis of productive capacity on the one hand and of consumption possibilities on the other (barring an altogether improbable immediate reduction in international trade barriers) shows that an interlude in production control would soon throw our farm economy into chaos again. Not all the forces that produced the great surpluses of 1929 are still in operation. Foreign lending by the United States has practically ceased, and prices no longer justify great expansion. Foreign countries, moreover, deliberately exclude our goods instead of receiving them willingly. Overproduction on a predepression scale is not likely to recur quickly under such handicaps. It may readily recur to a material extent, however, partly through natural recovery from the drought and partly through the incentive farmers always have to produce as much as possible. In a purely competitive situation individual farmers cannot hold back, though they may fully realize that collectively the result of not doing so will be bad.

### Our Acreage Requirements

How much farm production do we need for domestic use and for export? In the period 1928-32 the actual acreage of crop land harvested in the United States averaged 360,000,000 to 365,000,000 acres; and this area is much above that required, at average yields, to supply the present market, domestic and foreign. The necessity for continued farm readjustment is evident. The scale of the required change puts it beyond the scope of individual competitive action. Any attempt to dispense with concerted crop adjustment for the time being, on the theory that the adjustments so far accomplished do all that is necessary, would quickly come to shipwreck. Only a renewed opportunity for unimpeded export would give such an attempt a fighting chance. The opportunity for unlimited farm expansion in the United States is definitely over.

From 1919-20 through 1932-33, in years of depression as well as in years of relative prosperity, the average per capita consumption of foodstuffs in the United States was remarkably stable. Estimated in terms of weights sold in the retail market it averaged about 1,422 pounds for the period 1920-24, about 1,474 pounds for the period 1925-29, and 1,454 pounds for the period 1930-33. Total pounds of food used is not an ideal measure either of consumption or of changes in consumption, but it reflects the trend. The consumption per capita of different groups of food products is almost as stable as that of all groups combined. It seems fair to take the period 1925-29 as a standard for gaging requirements for the immediate future, because this period was as prosperous as any that the United States has ever known.



Assuming continued imports of such commodities as sugar and coffee, it would require from 285,000,000 to 290,000,000 acres to supply our present population with the same per capita consumption of food as prevailed in 1925-29. Consumption per capita of the non-food products, such as cotton, wool, tobacco, and flax, varies more than the consumption of food. To supply our present population with nonfood products at the 1925-29 level would require about 25,000,000 harvested acres. On a liberal estimate, therefore, we need perhaps 310,000,000 acres adequately to supply the home population with food and nonfood products.

The acreage requirement for export is declining. Our wheat exports for the season 1934-35 were even smaller than the 37,000,000-bushel total in 1933-34, which may be instructively compared with the 370,000,000 bushels exported in 1920-21. Exports of pork and lard in 1934-35 were likewise lower than in the preceding year when they totaled only 700,000,000 pounds as compared with nearly 2,000,000,000 pounds in 1923-24. Our exports of cotton and tobacco have been maintained at a more stable level. Exports of cotton, nevertheless, were materially reduced in 1934-35, and exports of tobacco did not exceed two-thirds of what they were in 1929-30.

The acreage required at average yields to supply our exports dropped from 84,000,000 in 1920-21 to 39,000,000 in 1933-34. With foreign trade blocked as it is by tariffs, quotas, embargoes, quarantines, subsidies, and such restrictions, the most that can be expected is a gradual increase. Probably we cannot count, for the immediate future, on an export demand for the production of more than 30,000,000 to 40,000,000 acres. All told, therefore, we shall not need more than 340,000,000 to 350,000,000 acres to supply the probable demand for home consumption and exports combined.

The difference between this figure and the actual acreage harvested prior to the depression does not represent the entire potential excess. By no means all the land available for harvest was actually harvested then. It would be possible, even without increasing the area in farms, to raise the harvested acreage considerably above the average (360,000,000 to 365,000,000) for the period 1928-32, since most farmers have more land that they could bring under cultivation were they so inclined.

### Acreage Adjustment Methods

The necessary acreage readjustment can be accomplished, theoretically, in several ways. One way would be entirely to cease cultivating a certain amount of land. On an extremely conservative estimate this course would necessitate leaving idle from 10,000,000 to 25,000,000 acres. Another way to make the adjustment would be to shift much land from intensive crops such as cotton, corn, and wheat, to pasture, hay, and forage crops; in other words, to reduce the intensity of cultivation. On this basis a shift of 20,000,000 to 40,000,000 acres would be required. Still another way to balance production with the anticipated demand would be to retire submarginal land. That would involve the biggest shift of all, and would involve perhaps 50,000,000 acres.

In some areas the production of certain crops should increase. In other areas, particularly areas subject to severe erosion, cash-crop



production should decline and farming should be shifted to a more extensive basis. Again, some areas have soil so poor that farming will not provide a good living under the best economic conditions. Past production in such areas is an unsatisfactory guide in making crop adjustments. Even in the first year's operations the Agricultural Adjustment Administration recognized the importance of allowing farmers some latitude in selecting the type of adjustment best suited to their individual farms. The tobacco contracts particularly permitted considerable flexibility in adjustments. In 1934 local committees in certain western wheat counties took individual farm-management practice into account in allotting quotas.

The 1935 corn, hog, and cotton programs provided for flexibility in allotments. Participating farmers, instead of having to make a flat percentage adjustment in their output, had the right to choose within a considerable range the adjustment best suited to their farms. Also the Agricultural Adjustment Administration encouraged erosion control and soil improvement by permitting land taken out of the production of basic crops to be used for soil-improving and erosion-preventing crops. Broadly, the object of a long-time farm-adjustment program should be to promote and encourage the best utilization of the individual farmer's resources, and at the same time to adjust farm production as a whole to yield the maximum farm income over a period of years. Essential to the program would be action to conserve soil fertility and to find other than farm uses for land not suited to farming.

### Advantages of Regional Approach

Crop adjustment on a regional basis would still be on commodity lines, to some extent, because of the geographical distribution of our principal crops, but it would allow for the important differences that exist in the farming practices of different areas. It is important to encourage sound rotation practice and to have the production of each farm managed so as to permit the most efficient use of machinery, tillage methods, and fields. Adjustments regarding wheat, for example, should not be identical for all farmers, no matter where they live or whether they specialize in wheat or simply raise it as part of their rotation. The same is true of cotton, corn, and hogs.

With a view to the better adaptation of the Agricultural Adjustment Administration programs to varied regional and local conditions, the Program Planning Division has begun a study for the purposes of which it has divided the country into 12 major agricultural regions, among which are the Corn and Cotton Belts and the wheat, range livestock, dairy, and other regions. Each of these regions has problems distinct from those of the others, and the regional problems must be considered separately and also in their interrelationship. By this means it is hoped, through close contact with farmers and with the cooperation of State agencies, largely to decentralize adjustment planning without sacrificing the objects of a coordinated national program. The problem, after determining the desirable volume of production for the important farm commodities, is to divide the total fairly among the different regions, with

an eye to long-time as well as immediate benefits, and then to allocate the production equitably among individual farmers.

This undertaking involves many difficulties, notably that of smoothing out interregional conflicts. As is well known, farmers in some States produce commodities for sale largely, not to the consumer in the first instance but to farmers in other regions. Thus the Corn Belt supplies feeds to the dairymen of the Northeastern States. These two groups of farmers, the one desiring to sell dear and the other desiring to buy cheap, cannot easily reach the same conclusion as to how much feed grain the country should produce. It can be shown that they have, at bottom, a substantial identity of interests. There is no ultimate advantage in excessively cheap feed to the dairy States; for the effect is to overstimulate dairy production, not only in the principal dairy States but throughout the country, and hence to make both feed growing and dairying unprofitable. But this is a farsighted view that farmers do not commonly recognize in the heat of their competitive struggles, and to give it scope in regional planning will require much study and thoughtful consideration and discussion. No central authority can impose a cut-and-dried plan. Only through processes essentially democratic, whereby all farm interests receive equal and adequate attention, can agriculture deal efficiently with the problem of regional adjustment.

But it should not be forgotten that the alternatives are difficult also, and less satisfactory. Essentially there are two: (1) A return to the old free-for-all; or (2) retention of the strictly commodity approach, with such modifications as it may permit. For the reasons already given, the relapse of American agriculture into blind unrestrained competition is unthinkable in the existing circumstances. As for the other alternative, retention of the strictly commodity approach in crop planning, it is certainly not less fraught with possibilities of individual and regional dissatisfaction than the more logical regional system. Essentially, the choice is not between cooperative crop adjustment or the repudiation of it, but simply a choice as to methods to be used in continuing some production control.

### Federal and State Cooperation

In the first steps toward a regional approach to the adjustment problem, the Department sought the cooperation of the State agricultural experiment stations in getting a better description of regional and area differences in agriculture. Previously, the experiment stations had been less active than the extension forces in the adjustment work. Regional adjustment requires detailed knowledge such as only the experiment stations can adequately supply; knowledge, for example, about regional and local matters such as the size of farms, the distribution of crops by areas within States, the choice of enterprises on individual farms, the local aspects of soil conservation, and the bearing of all these factors on farm incomes. Regional conferences held last March in each of the major agricultural sections clarified the task greatly. The deans and directors of the agricultural colleges and experiment stations, the State extension directors, and the heads of the economics departments in the various agricultural colleges, attended the conferences. The idea was to develop



recommendations first on a State and regional basis, and then in a coordinated national form, for agricultural adjustment to promote good land use; and finally to harmonize this technical purpose with satisfactory economic results.

The experiment stations adopted the program, and with funds supplied partly by the Agricultural Adjustment Administration began the necessary descriptive analyses. They differentiated their States into areas having similar types of farming, similar soils, crops, etc.; recommended changes considered desirable from the standpoint of soil conservation and good farm practice; estimated the probable effect on production and gross income, assuming various price levels; and developed adjustment objectives for dovetailing across State lines with the recommendations of other States having similar agricultural problems. Essentially, the experiment stations sought to answer two questions: (1) Into what type of farming areas may each State be divided? (2) What adjustment in the prevailing enterprises in these areas would be necessary to maintain fertility, control erosion, and promote efficient management? Representatives of this Department cooperated with the experiment stations in harmonizing their procedures so that the findings in all the States would be approximately comparable.

In August and early September the States presented tentative conclusions as to the adjustments desirable within their own boundaries. They based these conclusions on detailed information regarding the total areas in the different types of farming, the land in farms, the land in crops, the grazing and pasture land, the percentages of the crop land in various crops, the number of livestock on farms, and so forth. These conferences coordinated the State recommendations into regional reports. Sufficient progress was made to justify a start, in cooperation with the Agricultural Adjustment Administration, on plans for interregional coordination of cropping systems, with a view to developing the comparative advantages of different areas in a manner consistent with a sound national adjustment of agriculture to its physical and economic environment.

In the Corn Belt, adjustment centers around the feed grain-livestock problem and turns on the ratio of feed to grass and other crops that will best conserve land resources and give maximum net returns. In the small-grain region wheat is the center of interest. How many an over-extended cultivated area in wheat be adjusted to the restricted markets in prospect? In the range States the major concern is to differentiate the lands that can best be used for grazing and those that should be devoted to other purposes and to restore and maintain the productive capacity of the range. In the Southern States, where cotton and tobacco are the principal cash crops, the problem is to determine what acreages can be maintained without damage to soil resources and without oversupplying the available market. The problem of the dairy region is largely to determine a production and marketing policy in harmony with the domestic demand for dairy products and with the production adjustments that will inevitably go forward in other regions.

### Positive Program for Good Land Use

The task is to plan our agriculture so as to give the desired production for the Nation as a whole and at the same time to permit the individual farmer in the different regions and areas to follow the farming system best adapted to his conditions and to his farm. In the initial stages of the Agricultural Adjustment Administration programs the emphasis was necessarily on reducing production. Now, that these efforts, with the added influence of drought in 1933 and 1934, have reduced agricultural supplies to nearly normal levels the emphasis in crop adjustment must be shifted. It must be positive rather than negative and must allow for certain increases in production as well as for desirable changes in cropping systems. This is a logical outgrowth of what has been done already. In long-time farm adjustment it is imperative to advance from the historic base principle, with its tendency to freeze production by areas and by individual farms in the accustomed mold, to a method better adapted to good farm management and good land use. The transition from flat-percentage reductions to differential adjustments makes the task more complicated, but has the great advantage of being both fairer and more scientific. Also it enlists the cooperation of the farmers in definitely constructive operations, as distinguished from mere efforts to raise prices by cutting down supplies.

Because of the innumerable factors involved, it is important to proceed cautiously before adopting future programs or before discharging programs now in operation. It is desirable, in other words, to build on the framework that has been developed already and to retain what has stood the test of practice. Incorporating the new principles into action programs is necessarily a slow and gradual process, and the steps that can be taken immediately will carry us only a little way toward the goal. As experience accumulates, the pace can be accelerated. The Agricultural Adjustment Administration has set itself to the task of overcoming the difficulties and has taken important steps to shape its new programs to a new and more flexible pattern.

### SUITS AGAINST THE AGRICULTURAL ADJUSTMENT ADMINISTRATION

The year brought a widespread attack in the courts on the constitutionality of the Agricultural Adjustment Administration programs. The constitutional issues raised differ as to each of the different types of programs, although some common questions are involved in all. Three major types of administrative programs are being administered by the Agricultural Adjustment Administration:

1. The processing tax-benefit payment program, under which excise taxes are levied upon the processing of certain basic agricultural commodities and a sum equal to the proceeds of the taxes is appropriated for certain purposes including the making of benefit payments to farmers who voluntarily enter into contracts to adjust their acreage.



2. The marketing-agreement and order program, under which the Secretary of Agriculture enters into agreements with distributors and handlers of specified agricultural commodities and issues orders binding upon them to prohibit unfair marketing practices, to regulate to varying extents the marketing of the commodities, and in the case of milk and its products to fix minimum prices to be paid by the distributors to producers. The Secretary is authorized to issue orders to enforce restrictions similar to those contained in such marketing agreements upon distributors and handlers whether they are parties to the marketing agreements or not.

3. The Bankhead Cotton Act, the Kerr Tobacco Act, and the recently enacted Potato Act of 1935, which authorize marketing allotments and impose a special tax on the marketing of the commodity in excess of allotments.

In the first case in which the constitutional validity of the processing tax was challenged (*Franklin Process Co. v. Hoosac Mills Corporation*), the Federal District Court in Massachusetts, on October 19, 1934, held the tax valid. While an appeal from this decision was pending, the Supreme Court of the United States handed down a decision in *Schechter v. United States*, in which case the National Industrial Recovery Act was held invalid, chiefly on the ground that it contained an unconstitutional delegation of legislative power. Apparently largely under the influence of this decision, the Circuit Court of Appeals for the First Circuit reversed the decision of the lower court in the *Hoosac Mills Corporation* case and held the processing taxes involved to be unconstitutional. As in the *Schechter* case, the chief ground was that the taxes had been imposed pursuant to an unconstitutional delegation of legislative power.

### Amendments to the Law

In 1934 the Agricultural Adjustment Administration worked with committees of Congress in preparing amendments to the Agricultural Adjustment Act designed to simplify and facilitate its administration and to make possible the carrying out of the "ever-normal granary" plan. After the *Schechter* decision, the congressional committees revised these proposed amendments substantially, so as to define more explicitly the standards set up to guide and control the administration of the adjustment programs and to overcome the contention that the act improperly delegated legislative power. Congress passed the amendments as revised.

However, the decision of the Supreme Court in the *Schechter* case and the decision of the first circuit court of appeals in the *Hoosac Mills Corporation* case encouraged many processors to feel that the processing taxes might ultimately be declared unconstitutional. More than 1,100 suits were filed to prevent enforcement of the adjustment programs, most of them challenging the validity of the processing taxes. In a number of these cases temporary injunctions were issued to restrain the collection of the taxes. In a few cases decisions were rendered holding the taxes to be unconstitutional. By the end of September 1935 the suits had probably prevented the collection of about \$100,000,000 in processing taxes.

### The Constitutional Problem

The position taken by the Government on the constitutional questions involved may be summarized. The processing taxes are excise taxes, uniform in their operation both geographically and in their incidence upon all processors in the same class, and levied under the tax power granted to Congress in article 1, section 8, clause 1 of the Federal Constitution; the appropriation of sums equal to the proceeds of the processing taxes for benefit payments to farmers voluntarily entering into contracts for the adjustment of production is a proper exercise of the general spending power of Congress and within the proper purpose of taxation which limits the exercise of the tax power. The section provides that "the Congress shall have power to pay and collect \* \* \* excises to \* \* \* provide for the \* \* \* general welfare of the United States."

It is the contention of the Government that these appropriations are for a public purpose and for the general welfare inasmuch as the benefit-contract program is indispensable to the recovery of American agriculture and, therefore, indispensable to general national recovery from the depression. Moreover, the Government contends that the processing tax-benefit payment program does not contravene the tenth article of amendment to the Constitution (which reserves to the States and to the people powers not granted to the Federal Government) because the Congress is exercising only powers expressly granted to it in the Constitution—specifically, the taxing and spending powers.

Even if it be assumed that the Constitution does not empower Congress to regulate the volume of agricultural production, it does not follow that the exercise of powers indubitably granted to Congress in the Constitution becomes invalid merely because their exercise may accomplish something of the same result which might have been accomplished under a regulatory statute. In other words, where a given result may be accomplished in either of two ways, and the Constitution authorizes the Congress to utilize only one of those ways, the utilization of the authorized way does not become unconstitutional because the other way is not authorized. The tax provisions of the act, it is further argued, are separable from the appropriation of funds for benefit payments, and under the decisions of the Supreme Court, individual taxpayers may not challenge the validity of congressional appropriations.

### Taxing and Administrative Provisions

Also, the Government maintains that the taxing and administrative provisions of the law are not unreasonable, arbitrary, or capricious, but have a real and substantial relation to the object sought to be obtained and hence are not wanting in due process of law. Finally, the Agricultural Adjustment Act clearly and explicitly defines the standards to be observed, so that it involves no improper delegation of legislative power, but merely a grant of circumscribed power to fill in the details and administer the programs.



In authorizing the Secretary to enter into marketing agreements with distributors and handlers and to enforce the agreements through administrative orders, the Congress is exercising the power granted to it in the Federal Constitution in article I, section 8, clause 3, "to regulate commerce with foreign nations, and among the several States."

The Agricultural Adjustment Act authorizes the execution of such marketing agreements "only with respect to such handling as is in the current of interstate or foreign commerce or which directly burdens, obstructs, or affects interstate or foreign commerce in such commodity or product thereof."

The Bankhead Cotton and Kerr Tobacco Acts of 1934 and the Potato Act of 1935 are likewise exercises of the congressional power to regulate interstate and foreign commerce, and the allotments provided for in these acts are allotments for marketing in the channels of interstate and foreign commerce. In addition, taxes are imposed under the tax power on the marketing of commodities in excess of the allotments. These taxes, like the processing taxes, are excises for revenue-producing purposes and are uniform both geographically and in their incidence upon the class of transactions taxed. Amendments to the Bankhead and Kerr Acts enacted at the last session of Congress make the legislative standards that guide the administration of these laws more explicit.

## FOREIGN TRADE AND ITS ALTERNATIVES

In shaping a national farm policy the first duty is to conceive it in the national interest, rather than in the interest of any one group. This does not mean that it should necessarily benefit every citizen and every occupation equally and at once. It must plan first to remove inequalities. As part of our national economic policy, the farm-adjustment program depends for its success on the extent to which it promotes truly national ends. It cannot succeed as a purely occupational enterprise. Farmers are not strong enough numerically to assert their interests in opposition to those of other groups; and if they could, it would not be wise for them to do so. But we should distinguish between real and apparent conflicts. There would be a real conflict if farmers tried to undersupply the towns. There is only an apparent conflict when they urge that farm exports should be promoted by a more liberal import policy.

Certainly, lower tariffs would necessitate urban readjustments but there would be compensations. Lower tariffs would aid all people who purchase a varied bill of goods, including all consumers who are salary or wage earners and all industries except those that are not efficient enough to compete with foreign goods in the American market. Moreover, the adjustments necessary for less efficient industries would not exceed in difficulty or in cost the somewhat different adjustments that will be necessary if agriculture fails to regain its foreign market.

In the economic reorganization now in progress our less efficient industries cannot avoid making readjustments of one kind or another. They will certainly have to abandon their more exposed positions. By forming a united front with agriculture in the foreign-trade problem, urban industry will have better prospects of prosperity in

the long run. It may have to fall back temporarily at certain points, but only to prepare for a consolidated advance. Though the initial benefits may go to United States consumers and to our major export producers (both agricultural and industrial), even those engaged in sheltered industries will benefit greatly in the end.

### The Historical Trend

By this time the situation, in broad outline, must be familiar to almost everyone, and it should suffice to recall the outstanding features. Our economic life, both agricultural and industrial, has developed in close relationship with that of other countries, particularly those of western Europe. In the nineteenth century our farm exports to Europe, particularly of cereals, livestock products, and meats, reached tremendous figures. Not counting forest products, they amounted in annual value to no less than \$840,000,000 by 1900. There was some decline until the World War broke out, and then the farm export trade increased again. By 1918 it had reached a point 45 percent above the pre-war level, and the quantity of beef, pork, and cereals going to Europe was greater than at the height of the agricultural export trade during the nineties.

During the years immediately preceding the World War, this country's exports largely went not only to pay for our imports, but also to pay interest and principal on capital previously invested by Europeans in American rail, industrial, utility, and public securities. Our farm goods moved abroad easily because, in a sense, we had received payment in advance. During the war period foreign nations withdrew much of the capital which they had invested in the United States and we began lending to them. We became a creditor nation. Our export balance now constituted new foreign loans instead of debt payments to foreign countries. But after 1928 we practically ceased making foreign loans, and that part of our export trade which the loans had helped to maintain fell away. We made short-term loans from 1930 to 1933 which cushioned the falling away of that trade. At no time, of course, did loans finance the bulk of our exports. They financed the export balance. Nevertheless, the effect of our changed foreign lending policy on American exporters, both agricultural and industrial, was important. With foreign markets blocked, farm and factory production for export had to be reduced during these hard years even more than was the case for other production, with rural distress and urban unemployment correspondingly enhanced.

### Exports and Imports Interdependent

Permanently to regain any substantial part of our lost export trade, it will be necessary greatly to increase our imports of goods and services. Chiefly the increase must be in goods. There is no other sufficiently large possibility. Acceptance of goods in payment for our exports seems likely to be the only adequate basis for an indefinite time. The alternatives to thus exchanging what we produce above our domestic requirements for foreign goods that we could consume are not attractive. For the most part they would



involve a further limitation of farm production with additional unemployment in town and country or a drastic reorganization to produce things we are not well fitted to produce and a permanent lowering of our real standard of living.

Agriculture has suffered from the slump in exports much more than industry. Normally we export a large proportion of many of our most important farm products. In the 1920's the export share of the total farm production averaged about 14 percent annually, and this set the price on about 40 percent of what the farmer sold and materially influenced the prices of the rest. In volume it has since declined to less than 10 percent of farm production, with a much greater percentage decline in dollar value. In the fiscal year 1925 agricultural products made up 48 percent of our total exports. In the fiscal year 1930 the proportion declined to 32 percent. It rose to 42 percent in 1933 but declined to 39 percent in 1934. In the fiscal year 1936 (partly because of the droughts of 1933 and 1934) the agricultural proportion will probably be the lowest on record.

These facts indicate what the collapse of world trade meant to our agriculture, for the exportable surplus of any commodity or group of commodities tends to set the price for the whole supply. This was why Agricultural Adjustment Administration controls and the processing taxes were necessary. The collapse hurt industry too; witness the decline in our total exports: From \$5,284,000,000 in the fiscal year 1929 the business dropped to \$1,413,000,000 in the fiscal year 1933 and recovered only to \$2,008,000,000 in the fiscal year 1934. All over the world the sensational decline of international trade is one of the gravest aspects of the depression. American agriculture suffered disproportionately. Cotton, wheat, tobacco, and livestock enterprises could not be readjusted quickly to a domestic market. The acreage required, at average yields, to supply the export market declined from 84,000,000 acres in the fiscal year 1921 to 39,000,000 acres in the fiscal year 1934. To keep this acreage out of production indefinitely is defeatism.

### Probable Consequences of Export Paralysis

Without foreign trade, agriculture will have to continue crop limitation and seek compensation in higher unit prices. It will have to make detailed cooperative adjustments, with inevitable repercussions on nonfarm business. In the fullest sense, therefore, the agricultural problem is a national problem, the burden of which must be nationally shared. That is indisputable. There is room for dispute only as to ways and means, and as to the distribution of the cost. Nonfarm groups must decide whether to take the consequences of denying agriculture its foreign market, or to restore this market to the farmers at the cost of certain readjustments in inefficient industries. Nonfarm interests already know something of the penalties of farm contraction toward a domestic basis, but they fear that the other course, including tariff reform, would mean the contraction of urban industries. They see possible injuries but do not appreciate the compensations. Lower tariffs would create new employment by encouraging exports.

We have negotiated reciprocal trade agreements with some countries—Cuba, Belgium, and Sweden—and we have many other agreements pending. But progress is slow because the country does not yet realize that the penalties of the exclusion policy are greater than any that the opposite program would involve. It imagines that exclusion is the lesser of two evils. An example of the muddled thinking that prevails on this subject is the tendency of city dwellers to blame the Agricultural Adjustment Administration for crop limitation. Actually, the original cause is the country's refusal to allow agriculture to regain its foreign market. We fail to import goods enough to enable foreigners to buy our agricultural products. Lower tariffs could restore this market, and it is unreasonable and unfair to blame the effects of crop limitation on the crop-control machinery rather than on the tariff policy that makes the limitation necessary.

### The Industrial Viewpoint

Superficially the case against agriculture's plea for a more liberal import policy is plausible. Some urban industries, like the main branches of agriculture, are on an export basis and do not benefit from the tariff. However, much urban industry depends for its prosperity on the domestic market, which it naturally dislikes to share. Accepting imports for exports would tend to cancel our favorable balance of trade. It would increase the supply of commodities for consumption within the country. The increase, if the transaction were to benefit agriculture, would have to consist largely of nonagricultural commodities and of so-called "noncompetitive items." At first sight, then, the proposal to facilitate our farm export trade by lowering the tariff is a proposal to exchange a surplus of farm products for a surplus of industrial goods, and the manufacturer balks.

Turning our net excess of exports into a net excess of imports will necessitate one of two things, both distasteful to tariff-protected industry. It will involve either increased consumption or reduced production within the country; the first means lower prices, the second reduced employment in certain industries. With no compensation clearly visible, the manufacturer recoils. He prefers the bird in the hand. And who will blame him? Before the import program can make headway with the manufacturer, it is necessary to demonstrate that it will not simply rob Peter to pay Paul; that it is sound national economics and will benefit indirectly even the interests that seem the first to suffer. To do this we have to include all the items, not simply those that show up immediately in industrial balance sheets.

### Implications of Our Creditor Position

In the sum total of its trade balances with all countries, if we include the so-called "invisible items" in international transactions, we must expect a creditor country like the United States to develop an unfavorable balance. How this balance shall be composed, the proportion which the visible will bear to important invisible items, depends upon a variety of things, including credit conditions through-



out the world. Great Britain in the nineteenth century, for example, held down her unfavorable merchandise balance by accepting foreign securities instead of goods. Not until the World War broke out did she take goods almost exclusively in settlement of her claims abroad. When the United States became a creditor nation, it followed the earlier example of Great Britain, and insisted on the largest possible proportion of certain invisible items in the payments due. Instead of receiving goods and services in return for the things it had exported, it demanded promises to pay—stocks and bonds and other evidences of debt.

This course implied a belief that real, tangible payments would be made eventually. It rested, in other words, on confidence in international credit. As that confidence weakened, it became necessary either to forego export trade or to increase imports of merchandise and services. We can state the principle in another way. As world credit weakens, creditor countries demand their pay sooner. Sooner or later, export trade tends to generate a compensating import trade, and the only practical question is when to accept it. With interest accruing, the deferred commodity payment increases in physical volume. It is a case of receiving back, with an addition representing accrued interest, the commodity equivalent of what we send away or else of foregoing payment almost entirely. To develop an export trade, without simultaneously preparing for the inevitable return flow of goods and services, is economic idiocy.

For our enormous favorable trade balance during and immediately after the World War, we got promises and some services. Subsequently, for a smaller net export balance, we accepted more gold and took less of goods and promises. Finally we practically eliminated the promises; in other words, we refused any longer to accept foreign securities in payment for our exports. We are still hospitable to gold, but the supply will not last forever. Gold kept coming in during 1934 and 1935 partly because our dollar devaluation had increased the purchasing power of gold and partly because gold came here in a flight from shaky European currencies. This may have prevented our exports from falling lower. How long can it continue? Already the United States has nearly 45 percent of the world's monetary gold supply. More would be useless to us. Yet we have dodged balancing our exports by importing goods. Our excess of exports is disappearing mainly through a decline in the exports.

### Essentials of the Dilemma

We approach an impasse. In defense of the exclusion policy—or the refusal to take imports for exports—those who believe they profit by it point to its apparent effect on domestic production and employment. There is no gain whatever and probably a distinct loss because it limits the production of the things we are best fitted to produce. As a means of preventing unemployment, the exclusion policy is futile; for unemployment is not exclusively urban but also rural. Unemployment results quite as surely and in as large a vol-

ume from the present paralysis of export trade as from pressure on the prices of sheltered industries. Whatever reduces farm production reduces farm employment, immobilizes farm capital and farm land, breaks down the capital structure of agriculture, reduces farm owners to tenancy and farm tenants to wagedom, and creates a surplus of farm labor which must seek relief. Unemployment is also caused in the handling of farm exports. Refusal to take imports for exports may change the distribution of unemployment; it may pile rural unemployment on top of urban; but it does not reduce the total. Protection to one interest is greater damage to another. There is no ultimate gain even to the protected occupations; for out of wages, interest, and dividends the busy must support the idle. False stimulus to a few industries means greater distress for agriculture and greater need to divert industrial income to farm relief.

As a matter of fact, the exclusion policy actually creates unemployment. By paralyzing export trade, it keeps within the country (or makes it necessary to prevent the production of) a mass of surplus commodities for which the country has no need but which under favorable international trade conditions it could exchange for things it does need. Farm goods do not pass freely into consumption beyond a certain point no matter how much purchasing power may be available, as consumer requirements are not unlimited. The capacity of the stomach limits food consumption. Consumption of industrial commodities, on the other hand, may in many cases increase indefinitely with purchasing power. To exchange farm surpluses for industrial goods is therefore a direct means of promoting consumption. It changes the surplus into a form in which consumption is not checked by sheer lack of physical need but only when it encounters a shortage or maldistribution of buying power. Conversely, by refusing to exchange unwanted farm surpluses for foreign goods that could be consumed if we had them here, we prolong the surplus difficulty. We postpone the time when it will again be necessary for men to resume work; that is to say, we perpetuate unemployment.

### Obstacle to a More Liberal Import Policy

Taking imports to pay for exports should not embarrass a country, since the sale of one thing implies the power to buy another. When the United States sells cotton or wheat abroad it obtains command over an equal value in foreign goods. Why does it hesitate to bring in the goods? Why do many other countries similarly object to receiving imports for exports? The general insistence on one-sided trade, on selling without buying, suggests that there must be some good reason for it. There is. Taking imports for exports does not get rid of surpluses but merely changes their form. Something more than the exchange of dissimilar goods is necessary. Purchasing power must be distributed too. This is the real stumbling block. Reciprocal international trade, with each country's exports approximately balanced by imports, leaves the problem of matching consumption with production essentially unchanged and emphasizes the



necessity for internal adjustment. Whether exporting will create purchasing power enough to absorb the equivalent imports depends materially on who gets the purchasing power. To stimulate consumption, purchasing power must be in the hands of those who need or desire goods and services. International trade may increase needs or desires by creating opportunities to satisfy new wants. But if purchasing power is very unevenly distributed it will not create enough new wants accompanied by the power to satisfy them. So, restoration of international trade will not by itself eliminate the problem of the surplus. It requires the support of a domestic policy that maintains a distribution of the national income which will enable many potential buyers to be actual buyers.

### Income Redistribution Involved Inevitably

Here, then, is what we must recognize: The redistribution of income is not a proposal but a necessity. In one way or another it results automatically from any of the courses open to us. We cannot avoid it by ceasing to produce for export and by limiting our imports to necessities. That is to cripple agriculture, to make permanent the necessity for costly farm relief, to compel disadvantageous urban adjustments, and to create scarcity. The resulting unemployment involves heavy public expenditures. In such circumstances we first reduce the national income and then redistribute the reduced total to avert disaster.

The other course open to us involves a redistribution of income likewise, but under happier conditions. With production stimulated through international trade, the total national income would increase, and though the increase would have to be distributed so as to increase consumption per capita, the operation would raise the national standard of living. By this means we would be balancing the national consumption with the national production or its equivalent—and on a rising scale.

### Foreign Trade Benefits Well Diffused

Agriculture will not monopolize the benefit of a more liberal import policy even in the earlier stages. If we admit foreign goods into the United States, it will provide dollar exchange that other countries can spend. What they buy will depend on many things. Recently, foreign countries have reduced their purchases of farm goods in the United States. They have cut sharply their takings of cotton, diminished somewhat their purchases of tobacco, reduced to a very low level their buying of pork products, and practically ceased buying American wheat. On the other hand, they have increased their purchases of automobiles, radios, farm machinery, and other industrial goods. These differences reflect partly the relative superiorities involved in the different types of production, partly the geographic sources of the foreign buying. As a result of the drought, our ability to compete in the international market for wheat and hog products is temporarily low. In the case of cotton,

exchange difficulties are important. Cars, radios, and farm machinery, on the other hand, are going largely to agricultural countries whose tariffs are mainly for revenue; but American agriculture still has most of the natural and technical advantages that helped it formerly. Restored foreign buying power could not fail to stimulate farm exports, provided we have ordinary weather and Agricultural Adjustment Administration production policies are arrived at with common sense. The benefits of restored foreign trade ought to be shared, otherwise the motive for encouraging it and for making the necessary adjustments and temporary sacrifices would not persist. The choice of a liberal foreign-trade policy promises so much general benefit that even those who are involved in difficult readjustments can expect to profit in the long run.

### SIGNIFICANCE OF FARM IMPORTS

As farm commodity prices rise from the effects of the recent drought and of the Agricultural Adjustment Administration programs, agriculture moves toward an important decision. It must choose between action calculated to increase and action calculated to decrease its exports. Manifestly, domestic prices above world prices discourage exports and encourage imports. Is the remedy to be found in higher tariffs or embargoes? Farm imports have increased during the last year, and a demand has arisen for their exclusion.

It is certainly possible to exclude foreign commodities from the domestic market; but the action will tend at the same time to keep within the country products that should go out. That the refusal to import makes it more difficult for a country to export is a truism which applies whether the goods kept out are competitive or non-competitive. Practically, the question to be decided is whether a small gain in the home market is worth a substantial loss in the foreign market.

This country normally imports small amounts of competitive agricultural commodities, including those which it normally exports. Certain areas near the boundaries find it cheaper to pay duty than freight charges from distant points within the United States. Sometimes, too, we have domestic shortages, which imports supply. Again, certain types of products, such as cotton of a particular staple, may not be obtainable within the country.

In exceptional circumstances, such as those created by the drought of 1934, the farm imports may increase. They may include substantial amounts of the goods that we normally export, as well as quantities of products likely always to be in short supply in seasons of crop failure. At such times it may seem that the domestic producer, with his natural desire to make up for his low production by getting higher prices, should have the aid of special tariffs or embargoes. Our imports of grain, the domestic production of which was tremendously reduced in 1934, increased heavily on a percentage basis, but the imports of most other competitive commodities remained below the 10-year average (table 1).



TABLE 1.—Imports of certain groups of agricultural products

Group	Unit	10-year average, fiscal years, 1925 to 1934	Fiscal year 1935
Fruits.....	Short ton.....	1,496,000	1,371,000
Fruits, excluding bananas.....	do.....	103,000	71,000
Vegetable oils.....	do.....	405,000	432,000
Oilseeds.....	do.....	771,000	706,000
Total.....		1,176,000	1,138,000
Meats.....	Pound.....	82,773,000	81,259,000
Vegetables.....	do.....	734,787,000	362,491,000
Wool.....	do.....	212,358,000	122,789,000
Dairy products.....	do.....	146,433,000	74,697,000
Eggs and egg products.....	do.....	17,566,000	6,219,000
Corn.....	Bushel.....	1,537,000	20,427,000
Oats.....	do.....	494,000	15,614,000
Barley.....	do.....	84,000	10,978,000
Wheat.....	do.....	<sup>1</sup> 838,000	<sup>1</sup> 5,906,000
Rye.....	do.....	<sup>2</sup> 78,000	<sup>2</sup> 8,146,000
Hay.....	Short ton.....	1,204,000	11,230,000
Value of total agricultural imports.....	Dollars.....	99,000	88,000
		1,660,252,000	970,853,000

<sup>1</sup> Full duty.<sup>2</sup> 4-year average. Wheat unfit for human consumption.

### Demand for Exclusion

The increase in grain imports caused a wide-spread demand, among both farmers and nonfarmers, for higher tariffs and even embargoes on these and other farm imports. It is inconsistent, said those who demanded such action, to import goods the production of which we restrict within the United States.

That sounds very logical. Actually, however, the issue is not nearly so clear cut. It would, of course, be absurd to throw the United States wide open to world competition in goods that we can and do produce abundantly and efficiently ourselves. Such action would at any rate be absurd under present circumstances, with agriculture overexpanded, with farmers at their wits' end for an adequate market, and with crop-adjustment programs in effect.

No one suggests that we should do that. The reality is quite different. The farm imports now entering the United States are only a trickle, and there is no chance that they can become a flood. On a percentage basis the rise in grain imports looks portentous. In comparison with our domestic grain production the inflow is insignificant. It constitutes a very small fraction indeed of the domestic production. It is estimated that the 1934 drought caused, independently of the Agricultural Adjustment Administration crop adjustments, a decline of more than 2,000,000,000 bushels in our grain production. Our grain imports from July 1, 1934, to June 30, 1935, were less than 3.5 percent of the loss of all grains due to the drought, and only 1.5 percent of our average grain production in the years 1928-32.

During the fiscal year 1935 our wheat imports for domestic consumption (which does not include bonded wheat imports for milling and reexport) were 1.6 percent of our average annual wheat pro-

duction from 1928 through 1932. Our corn imports during the same period were 0.8 percent of our annual corn production. Normally the United States consumes practically all the corn it produces and builds up a surplus following good years. In a subsequent period of low yields this surplus may disappear quickly, and it may be necessary to import some corn. Small quantities of corn may be imported for use on the Atlantic, Pacific, or Gulf seaboard, even following seasons of normal production in the United States. That the last 2 years of drought have created a situation favorable to corn imports is not surprising; had the Government not greatly reduced livestock numbers last year it would have been necessary to import considerably more corn. Our imports of oats and barley, though relatively larger than our imports of corn and wheat during the fiscal year 1935, were actually quite small. Oat imports were 1.3 percent of the average (1928-32) production. Barley imports were 3.9 percent of the average production; rye imports were 29 percent of the average production.

### Imports Entered Over the Tariff Wall

These imports all came in over the regular tariff wall in accordance with the Tariff Act of 1930. Wheat paid a duty of 42 cents a bushel, corn 25 cents, oats 16 cents, barley 20 cents, and rye 15 cents. It is worth noting that the imports were relatively largest in commodities not covered by Agricultural Adjustment Administration programs, as for example, oats, rye, and barley. The drought was exclusively responsible for the diminished production of these crops. Beef imports paid a duty of 6 cents a pound or not less than 20 percent ad valorem for canned beef.

There was no change in the tariff duties except on hay and straw. On these commodities, in response to a petition from livestock producers, the President issued a proclamation, effective August 30, 1934, temporarily removing the tariff, and hay came in duty-free for consumption mostly in drought areas near the Canadian border.

With normal growing weather and larger production in the United States, the imports will decline. With reduced livestock numbers, even a moderate corn crop this year would produce a supply sufficient for domestic requirements. Points near the seaboard may import small quantities, in preference to getting supplies by rail from the Corn Belt; but the amount will be trifling. Normal yields of wheat, oats, and barley would eliminate the necessity for importing these commodities, though in any years of low yields some foreign shipments may come in.

The logical way to prevent that would be to maintain larger domestic carry-overs. It might be cheaper and more efficient to allow occasional imports, because the irregularity of the high- and low-yielding periods makes an ideal distribution of wheat, oats, and barley very difficult. Small imports of butter should be considered normal from time to time, because our butter production is ordinarily just about enough for our domestic requirements.

### No Reason For Alarm

There is consequently not the slightest reason to be alarmed over the recent moderate increase in certain farm imports. Tariff policy should consider not the exceptional but the normal position of the commodities to which it applies. Tariffs are usually not effective on commodities which farmers normally export in large quantities. Such tariffs become effective only when these commodities temporarily shift, through crop failure, to an import basis; and the beneficial effect on prices disappears as the production returns to normal. Meantime, in the periods of shortage, farmers get world prices plus the tariff; they could not do appreciably better by shutting out the imports altogether.

Producers will generally find it more satisfactory, both in production and in fiscal policy, to plan on conditions that are likely to remain fairly stable. Much permanent advantage cannot be derived from frequent tariff readjustments designed to meet temporary and exceptional conditions, mainly because it is impossible in tariff making to keep step with every seasonal change in supply and prices.

Wheat, corn, and rye, for example, might be back on an export basis, and thus be incapable of profiting from tariff protection, almost before new tariff regulations could be put into effect; and the same could happen with other products. With its chief farm products the United States is still heavily on an export basis. Even in 1934, with production tremendously curtailed by drought, it exported more than \$650,000,000 worth of cotton, tobacco, meat products, grains and grain preparations, fruits and fruit preparations, and dairy and poultry products (table 2). In framing agricultural tariffs this fact should never be forgotten.

TABLE 2.—Value of exports for calendar year 1934 and for fiscal year 1935

[In thousands; i. e. 000 omitted]

	Calendar year 1934 <sup>1</sup>	Fiscal year 1935 <sup>1</sup>		Calendar year 1934 <sup>1</sup>	Fiscal year 1935 <sup>1</sup>
Meat products.....	\$35, 169	\$33, 080	Tobacco, unmanufactured .....	\$125, 064	\$120, 515
Dairy products.....	5, 195	5, 270	Cotton, unmanufactured.....	372, 755	333, 586
Eggs and egg products.....	478	513			
Grains and preparations.....	39, 410	31, 321	Total.....	650, 188	595, 135
Fruits and preparations.....	72, 117	70, 850			

<sup>1</sup> Preliminary.

### Bad Effects of Prohibitive Farm Tariffs

It may seem that agriculture could profit from high tariffs on export crops in seasons of shortage, and lose nothing in seasons of surplus. That is not so. High tariffs on export crops, besides being useless most of the time, commit agriculture to a high-tariff philosophy, encourage other industries to demand prohibitive tariffs on their goods, and provoke retaliatory action abroad. Thus, without safeguarding agriculture's home market, they damage its foreign market, the basis of which is reciprocal international trade. Agri-



culture cannot demand a high tariff for itself and a low tariff for urban industry; and yet without tariff adjustments downward it must resign itself to a permanent and progressive loss of exports.

Our farm export trade in 1934, albeit much reduced from the pre-depression level, was still essential. Though crippled by special foreign tariffs, quotas, and exchange controls, it provided an indispensable safety valve. It is far more important to work for the removal of the handicaps than to employ their equivalent ourselves in an effort to give the American farmer the whole American market.

Normally the farmer has practically that whole domestic market, anyway; for him to give up the possibilities of regaining the foreign market for the sake of the trifling additional advantage of making the domestic monopoly absolute would be extremely poor business. In 1934 our imports of commodities competitive with the cotton, tobacco, meat products, and grains which we exported, including \$24,000,000 of practically noncompetitive bananas, amounted to only \$126,000,000, as compared with the \$650,000,000 worth of exports (table 3). Prohibitive tariffs would tend to sacrifice the larger to the smaller item.

TABLE 3.—*Value of imports for calendar year 1934 and fiscal year 1935*

[In thousands; i. e., 000 omitted]

	Calendar year 1934 <sup>1</sup>	Fiscal year 1935 <sup>1</sup>		Calendar year 1934 <sup>1</sup>	Fiscal year 1935 <sup>1</sup>
Meat products.....	\$12,812	\$16,650	Tobacco, unmanufactured...	\$24,932	\$23,913
Dairy products.....	10,864	14,289	Cotton, unmanufactured.....	9,456	7,870
Eggs and egg products.....	443	1,057			
Grains and preparations.....	33,212	59,897	Total.....	126,442	161,818
Fruits and preparations.....	<sup>2</sup> 34,723	<sup>2</sup> 38,142	Bananas.....	24,104	26,594

<sup>1</sup> Preliminary.

<sup>2</sup> Including bananas.

Reasonable tariff protection for agriculture, such as it has now, is necessary and desirable, but it does not follow that increased protection would give commensurate benefits, even on the few commodities which such protection could temporarily affect. The imports it would exclude are comparatively small, and their exclusion would have very little effect on prices in this country. In some cases higher tariffs or embargoes might cause an advance of prices; but whether such advances would produce more income for the farmers is another question.

Probably they would not. Extreme limitation of supply, below the basic needs of domestic consumers, whether accomplished through acreage control or through tariffs and embargoes, is neither a sure nor a justifiable means of increasing net farm income. Such action often hurts the consumer without helping the producer, because as prices rise consumption falls. At a given point, decrease in consumption can offset the advantage of higher prices. In the first months of 1935, high prices due to last year's drought caused an increase in our imports of butter; but the high prices

had still another undesired effect. They caused a sharp drop in butter consumption, which in February was 24 percent less than in February 1934. Farm income depends on the volume of sales as well as on the unit prices received, and price gains brought about through a rigid exclusion of imports would not produce more income automatically.

It is important to remember also that price gains produced by special tariffs would not last because they would overstimulate domestic production. Agricultural Adjustment Administration controls, since they depend essentially on the farmers' wishes, would not be a sufficient safeguard. With imports totally excluded, farmers would not wait for normal growing conditions to supply the demand. They would anticipate matters and produce new surpluses.

Recovery from the drought will cause farm imports to decline without the aid of higher tariffs, and this natural decline, reflecting more adequate domestic production, will increase the producers' income and inflict no hardship on the consumer.

### DUAL-PRICE SYSTEMS

There are proposals to establish a dual-price level for farm commodities by means of export subsidies, rather than by the means provided in the Agricultural Adjustment Act. The Agricultural Adjustment Administration method maintains dual prices for the basic commodities subject to processing taxes, and permits dual-price operations in marketing agreements. Domestic consumers pay the processing taxes, while foreigners do not. The result is that the taxed commodities cost more within the country than outside it. But the Agricultural Adjustment Administration method tends to narrow the spread between prices to consumers at home and prices to consumers abroad, because it promotes an adjustment of supplies to market requirements, and works toward a situation in which the processing taxes may be reduced. The proposed alternatives would have the opposite effect. Export subsidies without production control would overstimulate production and force world prices down. The subsidies would have to be constantly increased, so as to move out an ever-increasing export surplus. Otherwise domestic prices too would fall.

Not all the advocates of export subsidies favor the abandonment of production control, but the proposal leads naturally in that direction. Temporarily it would raise domestic prices to all producers, without regard to their participation or nonparticipation in crop control. Thus it would weaken the incentive to adjust output to the real demand. Some proponents of the export subsidy urge frankly that production control should be dropped. They hold that any quantity of farm products can be sold in world markets at some price and that no matter how low world prices may go the farmer can be assured of parity on the domestically consumed part of his crop. It is important, they believe, to retain the foreign market at almost any price.

Two such plans, the McNary-Haugen plan and the export debenture, were advocated widely in the decade of the twenties. Both



contemplated a two-price system—one price level for American products sold abroad and a higher price level for the same commodities at home. Under the McNary-Haugen plan export surpluses would have been segregated from domestic supplies and sold abroad for any price obtainable. The domestic supplies, thus brought to the point of shortage, would have commanded a price higher than the world price by the amount of the tariff. Out of this enhanced domestic price, each grower would have contributed an equalization fee to cover the loss on the exports. Under the export-debenture plan exports would have been encouraged by a subsidy derived from tariff revenue; and this bounty on exports would have raised the domestic price above the world price. Under either plan there would have been danger of stimulating production greatly, and also of causing foreign countries to adopt retaliatory measures. The lowering of world prices would certainly have aroused objections abroad.

Prior to the world crisis of 1929 these difficulties did not appear to be insuperable. Some economists believed foreign countries would be glad to get our farm goods at bargain prices and would not regard the "dumping" involved as seriously objectionable. After the crisis this opinion had to be revised. It was no longer a question so much of the desirability as of the practicability of selling unlimited quantities of farm products abroad. Prices of cotton, wheat, and other products were extremely low in 1932; but the supplies could not be exported freely. With wheat for the crop year 1932-33 averaging only 37.9 cents a bushel on American farms, the exports were only 41,211,000 bushels, or less than one-third of the pre-war and predepression normal. Hogs in 1932 were down to \$2.73 a hundred pounds; yet exports of pork were only 1.7 percent of the total production, as compared with 9.8 percent from 1920 to 1924. Cotton exports increased; but cotton prices were so low that the gross return to producers was the smallest since 1901, and the increased export volume went to increase the stocks rather than the consumption of American cotton abroad. The result was that our cotton exports declined in subsequent years.

### Expense of Forcing Exports

Exports could doubtless have been increased by very large subsidies even during the worst years of the depression; but the cost to the United States would have been tremendous. With production unchecked, such subsidies would have involved presenting to foreigners at less than its value an ever-increasing proportion of the agricultural output. One result would have been a constant widening of the spread between domestic and world prices. Moreover, the plan would have stimulated manufacturing abroad and discouraged it at home, because foreigners would have been able to undersell Americans in world markets with goods processed from American raw materials. Any action that keeps American prices above world prices has this effect to some extent; and a program that tends progressively to increase the differential is profoundly objectionable.

Furthermore, one country after another adopted antidumping laws and trade restrictions of various kinds. The world gave clear notice that it would interpose effective barriers to dumping programs.



There was every reason to expect, moreover, that exporting countries whose agricultural products compete with ours in the world market would try to counteract the effect of any export-bounty system which the United States might adopt. In the worst period of the depression it is probable that the adoption of the McNary-Haugen plan or the export-debenture plan would have prevented and not stimulated exports. Either plan would have prompted foreign countries to increase their trade restrictions.

Under the farm-adjustment program finally adopted the United States gave foreign countries no ground for complaint on the score of dumping. It served to raise rather than to depress world prices. True, the plan raised prices to domestic consumers more than it did to foreign consumers; but the supply adjustments strengthened the entire market, yet without sacrificing the foreign demand. American producers continued to offer all the tobacco and cotton that the foreign market would take; and it was the drought, rather than the Agricultural Adjustment Administration adjustments, which eventually reduced unduly the offerings of wheat and pork. In short, the Agricultural Adjustment Administration method did precisely the opposite of what a straight export bounty would have done, in that it served to regulate production in accordance with the capacity of the export market. A shift now to the export-subsidy plan would have manifest disadvantages. Exports can be increased, moreover, under the Agricultural Adjustment Administration programs whenever the opportunity offers. The processing-tax method, with its power to establish a differential between domestic and world prices, provides the necessary means.

### Limited Provision for Export Subsidies

Amendments to the Agricultural Adjustment Act, which were approved August 4, 1935, make limited provision for export subsidies as an accessory to the present method. Section 32 of the amendments appropriates a fund for: (1) Subsidies for the encouragement of exports, including among other things direct export subsidies; (2) subsidies to encourage the domestic consumption of agricultural commodities by diverting them from the normal channels of trade; and (3) expenditures to finance the regulation of production. For any one fiscal year the fund is limited to 30 percent of the customs revenue during the preceding calendar year. For the present fiscal year the amount available is \$92,000,000. But even if the whole of this amount were spent on export subsidies, it would not cover more than a fraction of our agricultural exports.

Clearly Congress did not intend that export subsidies should be adopted on a large scale. It will be necessary, in order to make the best use of these provisions, to confine export subsidies to cases in which such subsidies have a net advantage over all other methods. Also, it will be necessary to avoid subsidies that might tend to increase production for export significantly and give cause for foreign retaliation. In specific instances, as in the sale of wheat in 1934 through the North Pacific Emergency Export Association, subsidized exports may be desirable and feasible; but each case must be judged on its own merits. The course of action in respect to any commodity must fit the circumstances.

## FARM INCOME

Farm-income data, though not a perfect measure of farm welfare, are the best we have. They reflect the distribution of farm earnings by commodities and regions, the relationship between farm expenditures and farm returns, and the proportion which the farm income bears to the national income. The statistics do not measure all these relationships exactly. For example, the gross farm income includes the value, at farm prices, of home-grown products used by the farm family. This portion of the farm income is not the equivalent of money available for spending. The imputed money value of the home-grown products consumed on the farm may change, with no corresponding change in the benefits derived therefrom. Similarly, the money income of agriculture may change as a result of changes in the buying power of the dollar, in a manner and to an extent which do not precisely measure corresponding real changes in farm prosperity. It is desirable to bear these limitations in mind and to remember that fluctuations in farm income merely approximate the changes that take place in the production and distribution of wealth.

It is too early as yet to estimate, except very roughly, the return to farmers from their production in 1935. Marketing of the crops will not be finished until well along in 1936. Present indications are that the farmers' gross income from the year's production, and from rental and benefit payments, will be approximately \$7,800,000,000. This total may be compared with \$7,300,000,000 gross income from the production of 1934, and \$5,337,000,000 in 1932, when the depression was at its worst. In 1929, in which year the gross farm income was at the highest level since 1920, the total was nearly \$12,000,000,000. While the gross farm income for 1935 is approximately one-third lower than that of 1929, the prices paid by farmers for goods and services are about one-fifth lower. The 1935 gross farm income will have about four-fifths of the purchasing power that the gross farm income of 1929 had. Farm population has increased in the meantime about 10 percent, but some of the increase has been supported on relief. It would not be quite true, therefore, to say that this year's farm earnings must be spread over 10 percent more people than the earnings of 1929.

Naturally, the marked rise in the gross farm income since 1932 has been distributed unequally by commodities and regions. These crop and regional differences appear best in the statistics of cash income from marketings and rental and benefit payments, which, unlike the gross-income statistics, reflect current receipts. Cash income includes only current receipts, regardless of when the products were produced, and regardless of the time when the recipients of rental and benefit payments performed their contractual obligations. It constitutes the money return from agricultural operations, exclusive of the imputed value of the home-grown products used on the farms. Available cash-income data furnish regional comparisons up to June 30, 1935. It will be convenient to cite only percentage gains so as to avoid confusing the cash-income with the gross-income figures.

For the United States as a whole the cash farm income from marketings plus rental and benefit payments was 48 percent greater in



1934 than in 1932. In the South Atlantic region the increase was 81 percent; in the North Atlantic region it was 22 percent. The greatest advances occurred in the South Atlantic and South Central regions, which suffered the greatest decline in the 1929-32 collapse. From 1932 to 1934 the producers of cotton and tobacco benefited more than most other farm groups from the devaluation of the dollar and perhaps more also from the agricultural adjustment programs. Cotton and tobacco prices are determined to a large extent in the foreign market, and the depreciation of the dollar in foreign exchange raised these prices materially. Drought reduced the income from crops in the central regions in 1934, but heavy marketings increased the income from livestock. The period 1932-34 witnessed the restoration of a more normal balance among different crops; the years 1934 and 1935 brought new distortions which will influence the regional distribution of farm income for the next year or two.

### Regional Distribution of the Gains

For the country as a whole the cash income from marketings in the first half of 1935 was 13 percent higher than in the first half of 1934. The increase was greatest in the East North Central and the West North Central regions, and resulted principally from higher prices for livestock and grains. Improved conditions in 1935 tended to make the regional distribution of the cash income more normal in the second half of the year.

The North Atlantic States normally get 10 percent of the national gross farm income. In the years 1932, 1933, and 1934 they received 12.6, 11.8, and 10.9 percent, respectively. Low returns from potatoes reduced the percentage in 1934. The East North Central States, which normally have 17.6 percent of the total farm income, received practically that share in 1932 and 1934, and 16.6 percent in 1933, when the grain crops were small. The normal share of the West North Central States is 25 percent. They received 22.3 percent in 1932, 23 percent in 1933, and 21.9 percent in 1934, the year of the great drought. The South Atlantic States, whose normal share is 11.7 percent, got about 13 percent in 1933 and 1934. The South Central States received 22.6 percent of the total in 1933 and 20.8 percent in 1934, as compared with 22.2 percent in the predepression years. The Western States received about 16 percent of the total in 1933 and 1934, as compared with 13.5 percent in the predepression years. The West North Central States and the South Central States felt the depression more than the North Atlantic and the Western States.

Recovery in 1933 tended to restore the normal balance, but the drought of 1934 retarded progress in that direction. Advantages of the Agricultural Adjustment Administration programs in 1933 and 1934 were not confined to the regions in which farmers received rental and benefit payments. Indirect benefits resulted from the industrial activity which the programs stimulated. It is significant, for example, that car-lot shipments of manufactured goods from 16 Northeastern industrial States for use primarily by farmers in 10 Southeastern States showed an increase of 75.1 percent in the first year after the farm-adjustment programs and other recovery meas-



ures were started. The increased employment and increased factory pay rolls gave farmers better markets in nearby industrial centers. This was an important factor in the relative advantage of the North Atlantic States, as compared with the position of some of the other regions.

### The Purchasing Power of Farm Commodities

In studying the significance of the gross farm income, a basic consideration is the relationship of farm prices to nonfarm prices. An increase in the income available to the operator and his family may be entirely offset by advancing prices for nonagricultural goods and services. Since 1933, however, the prices received by farmers for their products have risen more than the prices of the things that farmers usually buy. It will be recalled that in 1933 the general level of farm-commodity prices was only 55 percent of the pre-war (August 1909–July 1914) average; whereas the prices of the things that farmers buy had dropped only to 100 percent of the pre-war average. In other words, farm commodities per unit had then only 55 percent of their pre-war purchasing power. Grain prices early in 1933 averaged only one-third of their pre-war level.

In the 2 years ended February 1935 the general level of farm prices more than doubled; since then the trend has been slightly downward. The greatest advances since 1933 have been in grain, cotton, and livestock prices. In the second half of 1933 and in the first half of 1934 the prices of the things that farmers buy rose rapidly. The result, of course, was partly to offset the advantage to agriculture of the rise in farm prices. In the last year or so the prices of commodities purchased by farmers have remained practically unchanged at around 126 percent of the pre-war level. In September 1935, when the farm-price index was 107, the purchasing power per unit of farm products for articles farmers buy was 86 percent of the pre-war average.

Another factor in determining the importance of the gross farm income is the level of production costs in agriculture. In the last 2 years farm costs of production have increased less than the gross farm income. This is a typical phenomenon in periods of recovery from depression and tends to compensate for the opposite condition which prevails on the down-turn. Changes in production costs lag behind changes in prices, with the result that in a period of recovery the margin of income over expenditures increases. Thus in 1934 the gross income of agriculture was nearly \$2,000,000,000 more than in 1932, whereas the total expenditures for production were only about \$320,000,000 greater. Moreover, the principal increase in production expenditures was in capital items such as machinery, buildings, and repairs, which are in the nature of permanent improvements. However, farmers did not provide fully for the depreciation of their machinery and buildings.

### Valuation of Farm Assets

Still another significant factor in the welfare of agriculture is the change in the valuation of farmers' assets. This change may result from changing prices for farm land and livestock and from increases

or decreases in farm inventories. From 1930 to 1933 the value of farm property in the United States declined nearly \$22,000,000,000. It has recovered moderately in the last 2 years but is still nearly \$20,000,000,000 less than in 1930. On a reduced property valuation, a given monetary income will show a higher rate of return, and vice versa. On the relatively low valuation in 1934 the return to farm operators for their capital and management was estimated at 4.4 percent. Had farm-property valuations remained unchanged from 1929, the return to farmers for their capital and management would have amounted to only 2.6 percent in 1934.

After paying the current expenses of production, making allowances for the depreciation of their buildings and equipment, deducting rent to landlords, and deducting interest, taxes, and the wages of hired labor, the income available to farm operators for labor, capital, and management, from the production of 1934 was \$3,468,000,000 as compared with \$2,683,000,000 in 1933 and \$1,492,000,000 in 1932. The figures given above may be compared with \$5,669,000,000 for 1929, the last predepression year. These figures make no allowances for delinquencies in interest and tax payments, which in recent years have increased markedly. In 1934, however, the farmers paid considerable amounts in deferred taxes and interest; moreover, taxes continued to decline, and the amount of interest due was somewhat lower.

The gross farm income depends on the volume as well as on the prices of farm commodities, but the relationship is complex. Sometimes the maintenance of a satisfactory farm income requires a decrease in production, especially in years when surpluses accumulate; again it may require an increase, as in years following crop failures. From 1930 to 1931, in which period the prices of farm commodities dropped sharply, our farm production declined scarcely at all. Farm income in these years apparently declined somewhat less than income in other industries, because the large volume of production partly compensated for the low prices. Eventually, however, farmers became unable to offset low prices with large volume. They found themselves compelled to support their prices and incomes by reducing their output pending the disposal of accumulated stocks. Crop adjustments under the Agricultural Adjustment Administration helped to produce a notable recovery both in farm prices and in farm income in 1933 and 1934. In both years drought conditions and the revaluation of the dollar contributed to the upward price movement. The drought, however, reduced production below the most desirable level, and farm prices rose proportionately more than farm income. We now have before us the task of getting back to a more normal production of livestock and of working out the proper balance between adequate supplies for urban consumers and adequate returns to producers. Farm production will have to be increased substantially above the 1934 level in order to maintain farm income at the level established in that year and in 1935. In 1934 the volume of the farm output was 91 percent of the average for the period 1924-29. The current year's volume is now estimated at 89. The decline was primarily due to a reduction in livestock. The volume of crop production available for sale and consumption on the farm increased from 68 to 83 percent of the 1924-29 average, whereas



livestock production declined from 110 to 93 percent of the same base.

## AGRICULTURAL CREDIT

The increase in farm income in each year since 1932, together with measures that have been taken to reduce farmers' debt burdens, have resulted in continued improvement in agricultural-credit conditions. While the debt situation of many farmers, particularly in areas which suffered from drought, is still unsatisfactory, higher prices for farm commodities have brought farm income into better alinement with fixed charges such as interest and taxes.

Additional reductions in interest payments have been effected under the refinancing program of the Farm Credit Administration. During the year ended May 31, 1935, new farm-mortgage loans of the Federal land banks and of the Land Bank Commissioner amounted to \$928,000,000, bringing the volume of new loans, since the beginning of 1933, to a total of \$1,739,000,000. These loans, which have been used primarily for refinancing other indebtedness carrying a higher rate of interest, have thus been the means of effecting an appreciable reduction in farmers' annual interest payments. As a result of recent legislation, interest rates on Federal land-bank loans, which had been temporarily reduced to 4½ percent for a 5-year period, are further reduced for a period of 3 years beginning July 1, 1935. In the first year the annual interest rate will be 3½ percent and in the 2 following years 4 percent.

The Federal land banks are now making new mortgage loans at an annual interest rate of 4 percent, the lowest rate in the history of the system. Loans from other agencies, while in relatively small volume, have also tended toward lower interest rates. These reductions, which appear to indicate a permanent lowering in the average interest rate charged on farm mortgages, may be expected, eventually, to be recapitalized, in part, in relatively higher land values. To the extent that this recapitalization takes place, the equity of farm owners will be further enhanced. Of course, so far as new farmers are concerned, the higher land values thus resulting will tend to offset the advantage of lower interest rates.

Farm taxes, which have been declining since 1929, declined further in 1934, the average tax per acre in that year being about 5 percent lower than in 1933. The average reduction from 1929 to 1934 amounts to 37 percent, a reduction which has appreciably lessened the burden of the total fixed charges on farm property. Decreases in real-estate taxes, however, have been offset in part, in some States, by other forms of taxation, particularly by sales taxes.

Improvement in the facilities for providing short- and intermediate-term credit for farmers has been characterized by the further increase in deposits of country banks and in the loan operations of the production credit associations. In 20 of the leading agricultural States, net demand deposits of member banks of the Federal Reserve System, located in places of less than 15,000 population, increased 23 percent in the year ended June 1935. In the latter month such deposits, at a level equal to 80 percent of their 1923-25 monthly average, were 85 percent higher than the low point reached in April 1933.



## FARM LAND VALUES

Reflecting the continued agricultural recovery, farm real-estate values increased during the year ended March 1, 1935, for the second successive year. The improving market for farm land brought with it certain definite advantages to agriculture. It increased the equities of farm owners, made loan companies more willing to finance sales, encouraged tenants to consider buying their farms, and gave members of the older generation a chance to step out of active farming with less sacrifice than in recent years. The up trend resulted mainly from the improvement achieved in farm earning power and from aid extended by the Farm Credit Administration and by private lending agencies in the refinancing of mortgage debt.

Farm land values tend normally to vary with farm earning power, current and prospective, and the prevailing recovery follows a long period during which the curve was downward. This Department's index of the average value per acre of farm real estate rose, in the 12-month period ended March 1, 1935, from 76 to 79 percent of the pre-war level. Creditor agencies with farms for sale in some cases raised their asking prices, and the general tone of the farm real-estate market improved materially. The rise in valuations brought welcome relief to farmers who had seen their life savings approach the vanishing point. The increases in value were distributed throughout most of the principal farming sections, and evidenced the broad extent to which farm earnings had improved in the preceding 2 years. The greatest advances relative to a year ago took place in the Southern States. There were substantial gains in the East North Central States and in Iowa. In the western part of the Middle West and in certain areas of the Southwest, however, the drought of 1934 influenced valuations adversely.

Changes of ownership of farm real estate showed encouraging trends during the year. Fewer forced sales resulted from debt difficulties or from failure or inability to pay taxes. Forced transfers associated with debt declined from an estimated frequency of 28 to 21 farms per thousand of all farms. The decreases were general and occurred in nearly all the States. Changes of ownership resulting from failure to pay taxes involved 7.3 farms per thousand of all farms, as compared with 11.1 in the previous year. Voluntary sales and trades were estimated at 19.4 farms per thousand of all farms, as compared with 17.8 in the preceding year. Federal land banks reported increased sales, higher prices, and a larger proportion of the selling price received in cash payments.

### Dangers of Overvaluation

The returning market for farm real estate carries with it the reminder that rising farm realty values in the past have not always been without untoward effects on agriculture. The agricultural difficulties of the post-war depressions would have been far less serious had not farm real estate been greatly overvalued in the preceding boom. Prior to 1920 the belief appeared to be wide-spread that farm earning power would always increase; and in some areas more than half the current selling price of farm land reflected the expectation

of such a continued up trend in farm earnings. What happened may be illustrated by the situation in an important Middle Western State. In this State at the beginning of the century, the ratio of net rent to farm real-estate values was about 6 to 7 percent, but it dropped rapidly and by 1920 was about 3 percent. Farmers were borrowing money at 5 or 6 percent to invest in farm real estate valued so as to yield only 3 percent on the investment.

In the crash after 1920 net cash rents soon reached relatively stable levels, while farm valuations continued to decline. But farmers who had contracted to buy land at high valuations did not get relief. On the contrary, they had to reduce their standards of living to the limit in order to meet the interest and tax payments required by their fixed obligations. The ensuing tragedy of foreclosure and loss of homes should serve as a warning against the development of a similar situation in the future.

The farm-adjustment programs, the relief extended to farmers through the Farm Credit Administration, and the progress of general economic recovery have produced a substantial increase in net farm earnings. It should be possible to preserve these gains; but with the total market for farm products restricted as it is by international trade barriers, the achievements of the last few years do not justify extravagant capitalizations of farm income.

In the most favorable circumstances it is wise to keep valuations conservative. Farmers as a group cannot benefit in the long run by allowing an excessive proportion of their earnings to be absorbed in land charges. It is imperative to bear constantly in mind the fact that land charges come out of farm earnings and that speculation in farm land values accentuates booms and intensifies the ensuing depressions. It multiplies the difficulties of men who want to buy farms for actual farming.

### Interests Rates and Valuations

Another important development has occurred. Lending agencies, including the Farm Credit Administration, have reduced the rate of interest paid by farmers on long-term indebtedness, thereby reducing the proportion of the farm income required for fixed obligations and increasing the share available for living. The benefit to the debtors is obvious. But if the reduced interest rates are capitalized into higher land values, those who buy and borrow in the future at similar rates will not benefit materially, and the advantage of low-cost financing will be largely lost. With higher valuations and higher loans, interest costs in relation to farm income will not be much changed from what they were before the reduction in interest rates, and there will be more indebtedness to retire.

It is to be hoped that farmers generally will take advantage of the opportunity to raise their living standards and will not capitalize their increased incomes into real estate prices beyond a reasonable level.

### RURAL-URBAN BALANCE

That economic recovery requires a good working balance between agriculture and industry, between country and town, is a proposition that looks simple but is really complex. No one can object to balance



as a general principle; for balance is only another name for adjustment, without which nothing can live. Agriculture is a living organism whose life depends, like that of all other living things, on an equality between the inner strength and the outer pressure—on a favorable relationship between the income and the outgo, between the waste and the renewal, between the breaking-down and the building-up. All that goes without saying. Agriculture can prosper only in a balanced relationship with what is external to it, and a good balance for agriculture is necessarily a good balance also for nonagricultural business. But when we drop from the general to the particular and try to specify the form and character of the desired good working balance, we enter difficult ground. What is a good balance between agriculture and the rest of the economic system?

The Agricultural Adjustment Act, as amended in August 1935 makes parity prices for farm commodities an essential factor. Parity prices it defines as prices that will give farm products exchange value, in terms of commodities bought (plus interest and tax payments per acre in most cases), equal to that which they had before the World War. There is more, however, to good rural-urban balance than simply parity prices. That Congress recognized this may be inferred from the act, which requires action calculated to establish and also to maintain fair exchange value for agricultural goods, without injustice to the consumer. Parity prices established on a very high level, through excessive reductions in the farm output, would not last. Such prices could be attained but not maintained. Parity prices must harmonize with increasing consumption, if they are to endure. Farm prosperity depends greatly on several factors besides the relationship between farm and nonfarm prices—notably on the volume and the cost of production and on the distribution of purchasing power among consumers. In judging the progress we have made toward parity prices, we must not forget the importance of permanence.

Considered merely from the standpoint of price relationships, the agricultural situation seemed fairly good in 1935. In September the index of prices received by farmers was 107 percent of the pre-war (August 1909 to July 1914) average, as compared with 103 in September 1934 and 55 in March 1933. The March 1933 point was the lowest on record. This gain, in 2 years, of nearly 100 percent, exclusive of benefit payments, brought the purchasing power of farm commodities to about 84 percent of parity. With benefit payments added, the income from basic farm commodities was not far from the price-parity goal. For 14 of the basic commodities named in the Agricultural Adjustment Act the index number in September 1935 was 110 percent of the pre-war level, as compared with 107 for all farm products. On a cursory glance these price statistics may suggest that agriculture had approximately reached its goal and had achieved a good working balance with the rest of the community.

Such was not the case, as we may infer from the conditions that produced the apparently satisfactory price relationships. Prominent among them, of course, was the 1934 drought. Between 1922 and 1934 our farm production, as indicated in marketings, dropped as a whole only 6 percent. In itself this moderate reduction caused no hardship



to consumers. (Farm-commodity prices throughout 1934 averaged 10 percent below the pre-war level.) Yet it gave agriculture a considerable gain in net income. Had the reduction stopped at 6 percent, it would have been all to the good; but the drought, coming on top of the Agricultural Adjustment Administration programs, carried the output of some crops far below the level desired, reduced livestock inventories greatly, and menaced production prospects for 1935.

### Parity Prices and Parity Incomes

In consequence, farm-commodity prices advanced in the late months of 1934 and the early months of 1935, without a proportionate increase in farm returns. Moreover, the moderate income gains that did result went unequally to different farming regions, those benefiting most that had suffered least from the drought. It is not desirable to have parity prices for agriculture through the temporary effects of crop failure, for the double reason that such prices do not give farmers generally more income and do not promise to last. Moreover, parity prices realized suddenly from the action of the weather bear on consumers more hardly than would parity prices achieved gradually on a basis of expanding consumer buying power. The return of parity prices for many crops does not prove, in the existing circumstances, that the farm depression is definitely over.

As the statistics previously cited indicate, the moderate drop that took place in our farm production between 1932 and 1934 benefited the farmers substantially; but the sharp decline that resulted from the 1934 drought will not by any means increase the benefit proportionately. Beyond a certain point, price gains at the expense of sales involve a loss of income. Parity prices will not return parity incomes if the volume of production decreases excessively; and in estimating the effects of the drought on production it is necessary to consider not merely current marketings but the extent to which the calamity impaired farm production capacity. Its effects on foundation herds of livestock and on feed resources in both grains and grasses will be felt for several years. Meantime, farmers will set in motion production trends that may eventually, despite the Agricultural Adjustment Administration controls, overshoot the mark again and cause another cycle of overproduction. Just now farmers have a lively consciousness of the fact that less and less production does not give more and more income.

It is highly significant that while farm prices advanced 100 percent between March 1933 and March 1935, cash farm income for these months increased only 50 percent. It is true that cash income during the first 6 months of 1935, despite reduced marketings, was larger than in the corresponding period of 1934, but the gain in the income was proportionately much less than the decline in sales. In the long run the farm income depends on the buying power of consumers. After crop failures, consumers may pay as much for food products as they did before and receive less. But the end result, which not even the strongest measures can prevent, is renewed impetus to farm production, both at home and abroad. Experience shows that on an average, with livestock as with crops, the best net return to agriculture comes not from high prices engendered by crop failure but from a normal balance between production and consumer requirements.

### Adequate Production Essential

The full year 1935 will furnish a convincing demonstration that the best production policy for agriculture is adequate production for the available market. Crop reduction has reached the point of diminishing returns. The true measure of farm prosperity is the farm income rather than merely the relationship of farm prices to other prices. Scarcity conditions can raise prices almost indefinitely but not incomes. By reducing acreage and livestock breeding greatly, the farmers could raise their prices still more in relation to other prices, but they would penalize consumers, cause a big drop in the consumption of farm products, and stimulate farm competition. Parity prices are not an end but a means. They are necessary, but they are not all that is necessary to establish a good rural-urban balance. Farm income is a better criterion.

### The Farm Share of the National Income

That the farm share of the national income is still much below what it should be is evident. From 1910 to 1914, when the farm population was about 25 percent of our total population, agriculture's share of the national income averaged 17.3 percent. In 1932 the farm share averaged only 7.5 percent. Since then it has increased moderately; in 1933 the percentage was 9.9, and in 1934 it was 10.2. But for decades before 1929 the farm income averaged a little more than half the percentage that the farm population constituted of the total population. On the historic basis, the farm share should now be from 13 to 14 percent. True, the long-time trend does not surely indicate the relationship that should always prevail, because the conditions and the technology of agriculture change continually. Moreover, our present farm population, which this year reached a new all-time peak, includes large numbers who are not really necessary to farm production. The problem is to discover how the farm income may be increased so that it will stay increased for all the people who should be on farms.

Our farm population as of January 1, 1935, according to an estimate made by this Department, was the largest in the Nation's history. It was 32,779,000, an increase of 270,000 over the estimate for a year earlier. The increase resulted essentially from the excess of births over deaths on farms. But these figures do not indicate what should be the farm share of the national income because the distribution of population between town and country in 1934 was unstable. The movement of population to and the movement from farms, which is always large, in recent years has shown marked fluctuations. In 1934 more people moved from the country to the town than from the town to the country; for the first time since 1929 there was a net cityward migration, as there had been for a decade prior to the depression. It is estimated that 994,000 persons moved from farms to cities, towns, and villages in 1934, while 783,000 persons moved to farms from the urban centers. Many of the people who went to the farms between 1930 and 1934, however, found only refuge and not work there; they did not add permanently to the gainfully occupied farm population. Our farm population will



have to be stabilized under more normal conditions before we can draw deductions from it as to the proportion of the national income that should go to agriculture.

### The Criterion for the Agricultural Share

Since parity prices are not a sufficient test of what constitutes a permanently good rural-urban balance, it may seem necessary to find some other definite basis for determining what share of the national income should go to agriculture. For obvious reasons, it is impossible to set a definite percentage. Suppose the farmers were to force up their prices through scarcity until their income rose to 14 or 15 percent of the national total. Whether or not they could keep the gain would depend on many things, notably on industrial conditions. With continued heavy unemployment in the cities, large returns in agriculture would attract capital and labor into farming, and farm surpluses would reappear. Consumers would rebel against high prices, and the farm share of the national income would decline again. Lifted above the rest of the economic community, agriculture would come under heavy fire from all sides, and a rigid control of agriculture would be necessary to prevent a new disaster.

It is possible, nevertheless, to lay down a principle, if not a percentage, for regulating the farm share of the national income. Sound projects for increasing that share must not hurt other interests and must have enduring elements. Before agriculture can get and keep an increased share, the national income must be increased. The national income depends, of course, on the national production on farms and in factories; it is the country's total command of goods and services. As the total increases, the share going to agriculture may rise without cutting into the amounts available to industry and labor. This may happen with industry and labor receiving more than previously. Amicably to divide an increase in the national income, on principles consistent with social justice, is quite different from quarreling over a decrease produced through scarcity. With production rising on farms and in factories, agriculture could get a larger share of an increased national income without any hardship to other economic groups. A fair return for agriculture would harmonize with general economic progress.

### An Increasing Share of an Increasing Total

Fundamentally, the problem is to give agriculture its due share of the national income through an approach to abundance rather than through an approach to scarcity. This necessitates an increase in both farm production and factory production but at different rates. Agriculture has begun to plan for an increased output. But the result, unless urban industry, too, increases its output, will be lower relative farm prices and possibly a further decline in the farm share of the national income, if not also in the absolute income of agriculture. Agriculture cannot achieve its goal without the cooperation of industry. It must get industry to agree that parity income for agriculture should come about, not on an extremely high price level through competitive scarcity but on a lower level consistent with



increased production and consumption. Such a balance would harmonize with progress, with a rising standard of living in both town and country and with a just diffusion of the resulting benefits. It is vital, in redistributing the national income for the ends of social justice, not to jeopardize the amount. Agriculture may fairly ask an increasing share of an increasing total income but not an increasing share of a diminishing total.

As we exhaust the power of crop limitation to advance the farmers' cause, we must emphasize the importance of better reciprocal adjustments between country and town. Under certain conditions it is legitimate and necessary for both agriculture and urban industry to reduce production. Urban industry, however, has done so much more than agriculture. Nonfarm production in 1934 was 42 percent below the 1929 level, whereas farm production was only 15 percent below its 1929 level. The price situation was just the opposite. Industrial prices averaged only 14 percent lower than in 1929, whereas farm prices were 39 percent lower. Net income may be lost, just as surely by sacrificing volume to price as by sacrificing price to volume—by producing too little as by producing too much. Industry makes this mistake more generally than does agriculture. But in principle the case is identical for both farmers and manufacturers. Eventually the reduction program defeats itself. Besides impoverishing the community, it injures the producers, because the resulting rise of prices fails to compensate for the loss of trade. Because urban industry is under severer restrictions than agriculture, we may consistently urge upon industry a more liberal production policy. For the long pull the good working balance between country and town demands increased production in both fields and factories.

### Two Kinds of Surpluses

It is worth noting, incidentally, that the limitation of production, necessary as it may sometimes be, works against a satisfactory rural-urban balance. The object of reducing production is to get rid of surpluses and to bring supply into balance with demand. In one sense, the method works. It promotes the consumption of accumulated stocks and causes prices to rise. But in another sense, the method fails; for in the process of eliminating a surplus of goods, it creates a surplus of labor and also of capital. To limit production, competitively or cooperatively, is to limit employment. This obvious fact invites criticisms of both farm and factory controls. From the standpoint of the community as a whole, the second kind of surplus is no better than the first. All we have is a choice of evils. We do not advance toward a good working balance if in removing commodity surpluses we create surpluses of labor and capital. Both labor and capital run to waste if left in idleness, and the waste is irreparable. It is necessary to think of labor particularly in this connection; for workers must be maintained, even if their labor force cannot be used. The good working balance must include not merely a certain ratio between farm prices and nonfarm prices, and not merely a certain proportion between agricultural and industrial production, but also a shift of labor costs from tax bills to wage bills.

In a balanced economy, therefore, the removal of surpluses must include the removal from the labor market of surplus labor and of surplus capital from the money market. Obviously, this can be done only through increased production. Agriculture has an equal interest with other industries in the matter. Its interest in parity prices coincides with labor's interest in increased employment. Overemphasis on prices, to the neglect of production, leads to scarcity. Real recovery will end this negative phase and begin a period in which both production and consumption will increase. This holds for both agriculture and industry. The ideal is production based on human needs rather than on purchasing power arbitrarily limited. To reach or even to approach this ideal requires a break, not necessarily with the control but with the restriction of production. Though more production ordinarily means lower prices, it need not mean smaller profits. Larger output at lower unit prices, with industry leading the way, is essential to safe progress toward parity prices and a fair share of the national income for agriculture. A good rural-urban balance will come about, not through extreme efforts to support prices at the expense of sales but through expansion at differing rates in fields and in factories.

### The Normal Trend for Industry

It should be noted that in a balanced abundance the trend of industrial production is normally upward at a higher rate than the trend of agricultural production. This was the case throughout the nineteenth century and during the first three decades of the twentieth century. There were interruptions of the trend—particularly after the War of 1812 and the Civil War. Broadly, however, the growth of prosperity, especially in recoveries from depressions, involves an increase in industrial production relative to agricultural production and a decline in industrial prices relative to agricultural prices. This is inevitable. Wherever total production increases and living standards rise, people naturally spend more for other goods and services than for food and clothing. Their action necessitates a greater increase in industrial than in agricultural production, accompanied by a decline in industrial prices relative to farm prices. Farm production may continue to increase, though at a slower rate. Then the country moves toward a balanced abundance. Agriculture gets a fair share of the national income, not through rivalry with industry in reducing production but through fair exchange values brought about by differing rates of increase in production.

### AFTERMATH OF THE DROUGHT

Weather conditions affecting agriculture in 1935 were in striking contrast with those of the preceding year. The general drought of 1934, which had prevailed over a great part of the country, came to an end. In the areas which had suffered worst, sufficient rain fell to check wind erosion, allay dust storms, and promote crop growth. The central valleys had too much rain, at any rate during the spring and early summer; and less than the usual percentage of the country suffered from deficient moisture. Of course somewhere



or other in the cropped areas there is drought every year. This year, as if by way of compensation for her niggardliness in 1934, nature inflicted subnormal moisture conditions mostly on States which, nevertheless, still had sufficient moisture for crops.

The drought of 1934 began to break in the fall months, when timely rains relieved the acute situation in most regions and prepared the soil for winter cereals. Especially favored were the eastern and northern Great Plains, which had suffered tremendously during the crop-growing season. Only in the southwestern part of the Wheat Belt did the drought persist. Additional relief came to most areas in the spring of 1935, with the continued exception of the southwestern Great Plains. Early spring rains in the northern Great Plains, where dust storms had been severe in 1934, prevented wide-spread harmful soil drifting, and created favorable crop prospects. Finally, in May, heavy rains fell also in southwestern Kansas, southeastern Colorado, northwestern New Mexico, western Oklahoma, and the Panhandle of Texas, and ended the droughty, dusty conditions there.

However, the droughty conditions in a considerable southwestern area, including western Kansas, western Oklahoma, the Panhandle of Texas, and eastern Colorado, were only temporarily relieved by the heavy May rainfall. For following this, June and July again had marked deficient precipitation, and drought conditions became reestablished. In fact, at the close of July, scanty rainfall and high temperatures had produced drought conditions throughout the Plains and Rocky Mountain States. Some sections of the southwestern Plains received less than one-fourth of the normal rainfall in July, and high temperatures were persistent.

In the central valleys, where drought in 1934 approached the disaster point, rainfall in the spring and summer of 1935 was excessive and caused floods and serious crop damage. Frequent heavy rains delayed spring plantings and retarded crop growth. Most spring-planted crops in the interior valleys entered the summer much retarded. Considerable acreages intended for corn could not be planted to that crop, especially in the lower Ohio Valley, in Missouri, and in southern Iowa. Missouri farmers were able to plant only about two-thirds of their intended corn acreage. Many unplanted fields in the wet areas were later seeded to forage crops. Most States further west had ample irrigation water, mountain snowfall the previous winter having been heavier, and the irrigation water supply much greater than in 1934. In the area from Montana westward, however, the precipitation was insufficient.

Up to July 1, most States had received more than their normal rainfall, particularly in the interior sections of the country, where the excess for the half year ranged from 20 to 50 percent above normal. All the States except Florida, Georgia, the Carolinas, New Jersey, and the New England group received more rain in the first half of 1935 than in the first half of 1934. In the Great Plains region the increase ranged from 140 percent of the 1934 total in Texas to 230 percent in Nebraska. States west of the Plains had substantial excesses. California, for example, had twice as much rain as in the first half of 1934, and Arizona nearly two and a half times as much.



### The Continuing Effects

Though the great drought ended in 1935, its effects did not. These were chiefly of two kinds: (1) Effects on farm prices and current farm incomes, and (2) effects on farm methods and types of farming. The drought disguised the true relationship between the real capacity of our farms for production and the demand for farm products, and gave a new impulse to unbalanced production. The significance of this may not be wholly apparent for several years, but it begins to appear in mistaken views among farmers and others as to the justification of production planning. In the fact that the drought reduced production below the point desired, many people see evidence that farm production cannot be controlled. The drought complicated the adjustment problem and raised doubts regarding the possibility of solving it; and both results will be reflected eventually in farm prices and farm incomes. Sound farm adjustment and stable farm prosperity would probably be nearer had the drought not occurred; for nature's methods of eliminating surpluses usually do not work out to human advantage.

### Influence on Types of Farming

Complicated and important likewise are the direct efforts on types of farming in the drought areas and the indirect effects in other regions. In normally droughty territory the drought caused a serious loss of topsoil through wind erosion, emphasized the necessity for returning certain tracts to grass, indicated the advantages of more diversification, and showed the unwisdom of prevailing tillage methods. Also, it completed the ruin of many farmers who had been unable even before the drought to make ends meet. These effects in combination may ultimately cause farmers in the normally droughty territory to change their methods greatly.

In territory not usually droughty the worst effects of the drought will be temporary. Disturbed crop rotations and damaged pastures and legumes will be restored. Meantime farmers will resort to emergency hay crops such as soybeans and Sudan grass. Probably a permanent result will be a higher percentage of grasses and legumes and a lower percentage of grain crops in the cropping systems. There may be important temporary shifts in livestock production. In the western Corn Belt, for example, farmers are turning generally to increased cattle raising. On the whole, the tendency in this region will be to return to normal both in crop production and livestock production.

Regions in which the drought did little crop damage, such as the eastern Cotton Belt and the northeastern dairy region, will, nevertheless, feel the economic repercussions of the drought's effects elsewhere, but these indirect effects cannot be discussed as yet except in a speculative way. It is obvious, of course, that important crop shifts throughout a large region must significantly influence farming practices in other regions. The Great Plains could not turn much land from cereals to grass without affecting the crop enterprises of the dairy States and the South. Ultimately, the result might be

beneficial all around; but we cannot tell in advance, or know exactly what the result would be. All we can say with confidence is that some of the consequences of the great drought will be permanent and will affect agriculture not merely in the drought territory but throughout the country.

### No General Retreat Likely

It is improbable that there will be any general retreat of farming from even the worst affected areas. The Great Plains and adjacent regions suffered from drought in the years immediately preceding 1934 and bore also the handicap of low prices for their products. Many farmers in these areas had come almost to the end of their resources and had seen their debts mount and their lands and their equipment depreciate. But the soil of the Great Plains and of neighboring areas is well adapted on the whole to wheat production and poorly adapted to other types of farming. Notwithstanding the drought, the Great Plains States in 1934 raised 216,000,000 bushels of wheat, in comparison with 280,000,000 bushels produced in the States east of the western boundary of Minnesota, Iowa, and Missouri, and west of the Great Plains. Wheat production in the Great Plains will certainly not be abandoned, though it may be continued under cropping systems considerably modified and necessitating a higher percentage of feed crops and more livestock. It should be dropped, nevertheless, in certain localities where the conditions of soil and climate are demonstrably adverse. Research should differentiate the areas adapted to wheat production from those in which such farming seems hopeless, at any rate under the market conditions likely to prevail in the next few years.

This research must consider not merely the physical but the economic factors, as the physical and the economic phenomena interact. Their reciprocal influence affects productivity as well as production. Certain price conditions may encourage soil mining, and leave agriculture unable to withstand price recessions. Relatively high prices for wheat during and after the World War brought under the plow much land in the Great Plains that might better have been left in grass and exposed the soil to wind erosion. When prices and yields declined together in the drought years, thousands of farmers were unable to carry on. The problem now is to determine what types of farming should be substituted under the present economic conditions for the types that have failed. It is necessary, in other words, to recalculate the economic and physical balance and to reorganize farm production on a basis that can be maintained with the yields and the prices that may reasonably be expected. Yields that returned a profit before 1929 may be insufficient now.

### The Situation in a Hard Winter Wheat Area

Farm-management specialists looked into this matter in a typical section of the hard winter wheat area, and their findings illustrate the problem admirably. They ascertained that, with production costs at the rate that prevailed in 1931, with the farm practices common to the area, and with wheat worth 70 cents a bushel at the farm,



the average farm operator would need to raise at least 9 bushels an acre, one year with another, to keep out of the red. Under the cost and price conditions assumed, they could pay a land charge of 6 percent on \$20 an acre, replace their worn-out equipment, and have \$600 left annually as labor income. By no means all the farmers in the area could expect to raise the necessary 9 bushels an acre from year to year. Some of them, moreover, had costs above the 1931 average.

In another area nearby the wheat yields averaged only 7.4 bushels per seeded acre in 6 years out of 10. This production was materially below the level necessary to pay the farm expenses and support the farm family.

Unit costs have declined somewhat since 1931, but not sufficiently to make farming in these areas profitable at materially less than 9 bushels per acre. Land that ordinarily produces less should clearly not be in wheat. Only the best soil should remain in wheat production, and the rest should be devoted to feed crops and livestock.

This is the outstanding lesson of the drought for the normally droughty areas. It does not dictate the total abandonment of wheat as a cash crop or condemn the farmers there to perpetual insolvency. It does emphasize the wisdom of specializing less exclusively, of keeping more land in pasture and forage, and of maintaining reserves both of feed and of capital for the inevitable season or seasons of drought. Also it emphasizes the importance of better farm practices. Surveys in the subhumid Wheat Belt showed that some farmers use tillage methods that prevent wind erosion, conserve soil moisture, and produce yields above the average for the region. In regions where the uncertainty of the rainfall is a permanent hazard, careful tillage and provision for making the fat years feed the lean are indispensable precautions. Not to employ them and to rely instead on the hope of making good seasons wipe out the losses of poor seasons, is perilous when prices are good, and absolutely ruinous when prices are low.

### Farm-Rehabilitation Problem

That the drought left a serious farm-rehabilitation problem in the worst drought areas goes without saying. It burdened many farmers with debt which they cannot hope to carry even under improved economic conditions, and created a difficult problem of refinancing. The Farm Credit Administration has refinanced a considerable number of farmers, but its facilities are inadequate for the extreme cases. Some creditors decline to reduce their claims in the hope that the Government will come to the rescue. It might be advantageous in many cases to let foreclosure take place, and to reestablish the displaced farmers on other farms less heavily capitalized. Part of the difficulty dates back to the overvaluation of land during and immediately after the World War; but the drought brought the trouble to a head, and indicated the necessity for dealing with capital charges as well as with the other aspects of the rehabilitation problem. The scars of the drought years in the subhumid territory will heal only very slowly, and not without attention to some very fundamental matters, foremost among which are



the complete retirement of some tracts from crop growing, the modification of cropping systems in other tracts, and the revision of capital charges in line with actual earning power. Nothing causes more farm distress in the long run than false views as to what the land can permanently produce.

Grazing in much of the Great Plains area presents a problem of rehabilitation second only to that of grain farming. The National Forest Grazing Administration and the Administration of the Public Domain under the Taylor Grazing Act have to deal with two portions of our western grazing resources, but the public forests and the public domain constitute only a minor fraction of the total grazing area of the Western States. Grazing land in private ownership presents quite as difficult a problem. Overgrazing is a problem on all our grazing lands; and, unless we take precautions, it will appear immediately on areas withdrawn from grain farming. It is imperative to reorganize range livestock production along more rational lines, with checks against overgrazing and with provision for carrying feed reserves against periods of drought. Withdrawing land from one improper use, merely to thrust it into another, is very inefficient, and improper grazing may destroy soil wealth as surely as improper cultivation.

### Emphasis on Beef Production

The reduction caused by the drought in the number of livestock on farms and ranches, and the resulting rise in livestock prices, has caused many farmers in the western Corn Belt to emphasize beef production rather than dairying. This development tends to allay the fears of farmers in the specialized dairy regions that the Corn Belt may become more competitive with them. Indeed, the production of beef in the Corn Belt may go too far and may cause eventually a sharp upward movement in the beef-cattle cycle, in a reaction from the abnormally rapid decline of 1934. Farmers still respond immediately to the stimulus of rising prices, without due consideration of price prospects. The restocking of western ranches began in 1935, when heavy rains improved range conditions, and the movement will temporarily support the prices of cattle to Corn Belt farmers. The demand from ranchers for breeding stock will be substantial; moreover, shipments of feeder stock and of animals for slaughter from the range will not be in normal volume for several years. But with full restocking of the ranges, the increase of cattle production in the Corn Belt will approach the danger point. It may demonstrate for this branch of agriculture what similar tendencies may demonstrate for other branches, that the sudden removal of surpluses through drought does not remove the need for production planning.

### LAND UTILIZATION

During the last half century four stages may be distinguished in the evolution of public policy toward agriculture in the United States. The first was characterized mainly by an interest in the technique of production. In that stage the Federal Government and State agencies confined their attention pretty largely to the

study of ways to decrease the cost and increase the volume of the farm output. That this was not enough came to be generally recognized about 30 years ago. Then came the second stage in which public agencies added to their production studies an increasing interest in the farm as a business enterprise. It came to be recognized that markets and prices have as much to do with the individual farmer's lot as his skill in raising crops. Accordingly public agencies investigated market conditions, practices, and prices, improved their crop-reporting services, and developed facilities for the standardization of farm commodities. In the third stage the concept of public responsibility for agricultural welfare widened again. It came to include a sense of the farmer's dependence on credit conditions, land values, land tenure, methods and conditions of land settlement, and the nonfarm uses of land. The fourth stage, which may be said to have originated with the passage of the Agricultural Adjustment Act in 1933, brought the essential features of the preceding stages into a higher synthesis, involving the whole adjustment of agriculture to its economic environment. This is the stage of comprehensive agricultural planning.

Concern with land, and with land use and land tenure, was the new aspect of public policy in the third stage of its development. Not until the policy had entered the fourth stage, however, did concern with land pass much beyond research, extension, and other educational activities. There was considerable progress in forestry and in the conservation of wildlife resources; but land settlement remained chaotic; public agencies did not try to coordinate the farm uses with the nonfarm uses of land and did not check wrong land uses. It was impossible to leave matters in that stage after the passage of the Agricultural Adjustment Act. Federal guidance in production control under that law created new Federal problems. New uses had to be discovered for land withdrawn from production for export, submarginal farming had to be discouraged, and crop adjustment had to be coordinated with land utilization in general. Crop adjustment involved land adjustment as an inevitable consequence. It would have been highly illogical to regulate the use of land in farms, and do nothing about the land not in farms. Land planning became an integral part of agricultural planning and, for the first time in our history, inspired vigorous action.

### Research in Land Use

Economists in this Department had studied land questions for many years before the necessity became compelling to put their conclusions to the test of practice. They investigated the tenure question, the taxation and capitalization of farm lands, the allocation of all our land resources among the various uses, the effect of uncontrolled farm expansion and land settlement, the relationship between so-called "submarginal production" and farm welfare, the bearing of individualistic land uses on public interests, the requirements of forest preservation, flood control, the prevention of erosion, and the role of public responsibility in the conservation of soil wealth. It had been recognized for nearly a quarter of a century that the Nation should assume responsibility for the conservation of forest



resources, and subsequently it came to be recognized that the same attitude should hold toward the conservation of wildlife. In these two respects study produced action. Succeeding national administrations reserved and acquired areas for national parks and forests and provided in a small way for refuges for migratory birds. On this basis of research and experience the Department is now erecting a broad and substantial land program.

It is true that the social control of forest and wildlife resources is as yet only partial. The national forests represent only a fraction of our total forest area. Four-fifths of the land capable of producing commercial timber is in private ownership, and this privately owned forest land is often poorly managed. The public has an interest in all forest lands, whether publicly or privately owned. On the management of these lands depends the permanence and stability of community life, and in no small measure the economic and social welfare of whole regions. We have made only a beginning in the protection of areas suited to wildlife. Yet in dealing with both forest and wildlife resources we are on the right path, as the results so far realized abundantly prove; and the public interest in methods of land utilization warrants action in other directions. Accordingly, Federal money is now available not only for the acquisition of forest and wildlife areas, but for cooperation with farmers and with State agencies to check erosion, for the better regulation of grazing lands, for the improvement of national parks, for the development of recreation areas, for guidance in land settlement, for the retirement of areas submarginal for farming, and for the relocation of farm families to save community expenses and promote better land use.

### A Joint Responsibility

The development of a national land policy is of course not exclusively the task of this Department or of any other single agency of the Federal Government. It is the joint responsibility of numerous public bodies both State and Federal. As a step toward coordinating different lines of attack upon the problem, the National Resources Board appointed a land planning committee, which surveyed the situation and issued a comprehensive report in January 1935. Many branches of the Federal Government cooperated in furnishing material and in drawing up recommendations. Among the cooperating units were the Bureau of Agricultural Economics, the Bureau of Agricultural Engineering, the Bureau of Biological Survey, the Bureau of Chemistry and Soils, the Forest Service, the Weather Bureau, the Agricultural Adjustment Administration, the National Park Service, the Office of Indian Affairs, the Geological Survey, the Reclamation Service, and the Soil Conservation Service. Representatives of State agencies conferred with the committee. In land planning it is essential to coordinate Federal with State programs because the States exercise a wide land jurisdiction and can do much through zoning and other methods to promote better land utilization. Moreover, much of the necessary initiative in a democracy should come from the governmental units nearest the land problem.

Public agencies engage in land planning, not for the sake of the land, but for the sake of those who use it. This principle, moreover, should not be interpreted too narrowly; for everyone lives on the



land, directly or indirectly. We cannot distinguish sharply between the urban and the rural population, because the two groups interpenetrate and continually exchange personnel. There is a constant ebb and flow of population between town and country in which the controlling factor is the balance of advantage between urban and rural occupations. Needless to say, land-use conditions affect this balance tremendously. In the pioneer epoch, when land was free or cheap, everyone had an obvious interest in the fact, regardless of whether or not he wished personally to take up land. In the greatly changed conditions that prevail now, the relationship between the individual and the land, though it takes a different form, is just as vital. Accordingly, the land planning committee of the National Resources Board dealt in its report with land planning in its immediate, as well as in its more remote bearings on human welfare. The broad conclusions it announced provide a solid basis for public policy.

### Findings of the Land Planning Committee

This country, with its comparatively low ratio of population to natural resources, may through wise land planning escape the hardships that other countries have suffered, the committee declared. It need not fear a land shortage. Though the United States has no land to waste, it has enough to provide for our maximum probable population and to maintain forests, wildlife areas, and recreation areas. Manifestly, however, the attainment of this end depends upon a nice adjustment between the use and the conservation of resources. Natural wealth should be available for the satisfaction of human wants, but not for getting rich at the expense of the community. Efficient land utilization, the report indicated, must rest on a new conception of our national interest, which will recognize the land resources of the Nation as the basis of its present and future prosperity and which will regard the private landowner as a trustee for society.

Specifically the report estimated that in 1960 our need for crop land will be about 30,000,000 acres greater than it is at present. It showed that we may satisfy this requirement and yet retain about 615,000,000 acres in forests and make substantial additions to national, State, and local parks and to bird and game refuges. The report also recommended that about 25,000,000 acres should be added to Indian reservations, in compensation to the Indians for land losses suffered by them under the former allotment system. It recommended a 15-year program for the Federal purchase of about 75,000,000 acres of submarginal land, including more than 20,000,000 now cultivated.

As a corollary to the last recommendation, it urged an active program with Federal and State agencies cooperating to control land settlement. It would be obviously illogical for public agencies to acquire submarginal land without discouraging the farming of similar lands not now cultivated. Yet the report did not shut the door tightly against land settlement. On the contrary, it recognized that the prevailing economic conditions may compel this country to provide for a larger proportion of its people on the land, and to abate the prevailing excessively commercial trend in agriculture in

favor of a less commercial, more domestic system. It affirmed not less vigorously, however, that no substantial movement of unemployed people from urban areas into commercial agriculture should be publicly encouraged.

### Action Already in Progress

These findings go to the roots of the problem. Some of them are already the basis of definite action, notably the Federal acquisition of lands unsuitable for farming, and the coordination of forest projects with wildlife conservation and the provision of recreation areas. The Federal Government has made a substantial beginning in the acquisition of lands unsuitable for farming and has broadened the program to include the purchase of other lands not used in ways consistent with the general welfare. It was necessary to broaden the program in this manner because the acquisition of farm units alone in many areas would create holdings not well adapted to public administration. By rounding out the purchase of submarginal farms with the purchase of cutover lands suitable for reforestation and of lands suitable for recreation areas or wildlife refuges, the program becomes an important auxiliary in park, wildlife, recreation, and forest planning.

The land-acquisition program was first established as the land program in the Federal Emergency Relief Administration, and financed by funds allocated to it by a resolution of the Special Board of Public Works in August 1934. The program was to include four types of projects: (1) Agricultural demonstration projects, wherein the land acquired for retirement from farming would be converted to uses such as forestry, upland-game conservation, grazing, or combination of these uses with recreation; (2) Indian lands demonstration projects, wherein lands would be acquired for use by certain Indians to improve their economic welfare and lessen relief costs among them; (3) migratory-waterfowl projects, in which land would be acquired for winter refuges and resting places along the migratory-waterfowl flyways for the purpose of conserving migratory waterfowl; and (4) recreational demonstration projects, to retire poor lands from cultivation and convert them to recreational use wherever that seemed advisable.

These four types of projects were carried on by the land planning committee not directly but through cooperating technical agencies. The agricultural demonstration projects were the immediate responsibility of the Land Policy Section of the Agricultural Adjustment Administration; the Indian land demonstration projects were under the jurisdiction of the Office of Indian Affairs of the Department of the Interior; the migratory-waterfowl projects were carried forward by the Bureau of Biological Survey of the Department of Agriculture; the recreational demonstration projects were the responsibility of the National Park Service of the Department of the Interior.

The program was transferred to the Resettlement Administration on June 1, 1935. At that time the program consisted of 250 projects providing for the purchase of 20,551,928 acres at a total cost for land of \$103,788,079. On these lands 54,563 families resided, including



approximately 29,000 requiring financial assistance to obtain satisfactory relocations elsewhere. Optioning of land was in progress within 217 of the 250 projects; and 8,973,913 acres were under option, providing for a total cost for land of \$38,976,741. Options covering 4,860,818 acres had been submitted to the Washington offices of the technical agencies. Options covering 3,318,532 acres had been authorized for acceptance and had been recommended to the legal division of the land planning committee for such acceptance. These options do not represent commitments of the Government until official acceptance letters have been sent to a vendor. At the time of the transfer of this program to the Resettlement Administration, official acceptances had been mailed out covering 3,044,047 acres, providing for a total cost of \$13,265,804.

### Wide Ramifications of the Problem

In acquiring submarginal lands, the Government touches human problems that ramify throughout our whole economy. Some areas should be retired completely from agriculture. In others it suffices to regroup farm families, and to aid them in farm management and community organization. Still other areas do not furnish an adequate family living under the prevailing methods of cultivation, but might do so were these methods changed. In some irrigation districts, for example, the number of families or the area in cultivation is too great for the water supply. Again, in parts of the Great Plains, some shift from cereals to grass is necessary to prevent wind erosion, and farm units must be larger to include pasture and livestock. Some areas which may be submarginal now might not be submarginal were they less thickly settled. On the other hand, certain areas need to be more closely settled, so that the cost per family for community services such as schools and roads may be reduced. Related to this problem in the relocation of farm families is the problem created by the drift of the urban unemployed to the open country, and the equally serious problem of what to do with rural youth that normally would go to the cities. That these are all aspects of a single problem goes without saying. That problem is nothing less than the total adjustment of our population to the available resources and economic opportunities.

In the first aspect of this great problem, the withdrawal from agriculture of land that should not be farmed, it is seldom necessary to contemplate the complete depopulation of submarginal areas. In the Lake States much land unsuited to farming is not far away from thousands of acres of comparatively good land lying unused. The transfer of population need not be total. Even the poorer areas include many fairly good farms; and the relocation of the families worst situated, on better lands nearby, raises the level of the whole community. Farm families may sometimes be relocated on lands which the present occupants are leaving, perhaps to retire, or to enter other occupations, or to send children to college. Sometimes it is possible in a district where the customary sources of cash income are declining, and where failure to discover a remedy would lead in the end to farm abandonment, to develop greater local self-sufficiency, through the communal interchange of goods and services. It is then not necessary to treat the area as submarginal.



### The Trend Toward Self-Sufficiency

Adjustment of land policy to these varying requirements raises an extremely fundamental question. How far, in the present circumstances, should we encourage less commercial, more self-sufficient types of farming?

The force of events produces a trend in that direction. Much of our agriculture has always been relatively noncommercial; that is, highly dependent on production for consumption in the farm home. In 1929 nearly half our farmers produced less than 10 percent of the farm commodities sold; now, as a result of the depression, the proportion of noncommercial farmers is even greater. It increases from the necessity to support on the farms the natural increase of the rural population, as well as a return flow of urban unemployed. In the last few years the rural proportion of the population has increased; and the increase, since it forces more people to depend on farming alone, involves some drift toward a less commercialized agriculture, in which farm production increases more than the sale of farm products.

It is one thing, however, to recognize the trend and another to accept it as desirable. As a matter of fact, the development is really an evidence that the depression continues, and a spontaneous reversal of the trend would be a sign of recovery. But this does not exclude the possibility that, for the time being, some increase in farm self-sufficiency may be the lesser of two evils, the other, of course, being rural unemployment.

For many decades technical progress in certain types of agriculture steadily reduced the quantity of labor necessary to produce a given quantity of foods and fibers and tended to develop a highly mechanized, capitalist type of farming chiefly characterized by production for the market. Such highly commercialized agriculture ceases, however, to be efficient when the labor it saves can be put to no other use. There is no point in saving labor merely to swell bread lines.

The advantage of labor-saving methods tends to vary inversely with the value of labor. It disappears when, from an economic standpoint, the labor it saves is not worth saving. In such circumstances the struggle for increasing mechanical efficiency is a dissipation rather than a conservation of energy. We have to determine which course involves the greater waste of human power: (1) Increased specialization in agriculture, with its tendency to drive men off the land; or (2) decreased specialization and decreased mechanization, with the resulting decrease in the production return per unit of labor used.

In certain areas which are relatively self-sufficient already, social planning should develop self-sufficiency still further. The alternative is farm abandonment. Complete self-sufficiency is, of course, impossible; that would mean a closed family economy and a closed family culture; in short, a reversion to an extremely primitive condition. But the areas in question are not, and never have been completely self-enclosed. They have always done some business with the outer world, and their special difficulty now is that their sources of cash income are dwindling.

The land has washed and does not produce for the market at a cost sufficiently low. Rural industries which formerly gave them both a market and some part-time work have moved away. Nearby timber resources have largely disappeared. What the farmers produce for sale must be shipped too far. Instead of moving out, however, they might explore the possibilities of increased production for their own consumption and with proper guidance might develop resources now neglected. Scientific planning could lead to improved housing and sanitation, more diversified production, better preparation of food, and the local interchange of services without the use of money. More efficient types of cooperation in social life could be developed, as well as more efficient modes of direct consumption.

### Landward Movements of Urban People

Quite different is the problem that arises when the unemployed move onto the land, though this problem, too, involves the relationship between commercialism and self-sufficiency in agriculture. The task of this group is to discover sources of cash income rather than to figure out means of lessening their dependence thereon. No farm group can dispense with cash income altogether. It is naturally more difficult to develop absolutely new sources than to endure a partial drying-up of old sources.

Refugees from the cities cannot depend for the solution of this difficulty on communal interchange, for that takes time to develop and in any case will not furnish a complete substitute for cash. Indeed, the supreme objection to lodging masses of the unemployed on the land is not their inexperience in agriculture but the impossibility of maintaining them there without supplementary employment. Not enough nonfarm work can be had. The result tends to be either withdrawal from the enterprise or an unprofitable effort to raise crops for the commercial market. Essentially, the amount of outside work that can be made available to part-time farmers depends on the total quantity of nonagricultural work that the country wants done. It does not suffice merely to take work from city people and give it to rural people.

There is limited room for urban people on the land. Though the mass settlement of the unemployed on farms cannot be justified, certain groups may advantageously combine farm with nonfarm work. Suburban living, with land enough to grow food, may unite the best elements of both urban and rural life and may cushion unemployment. Moreover, good roads and the automobile are gradually lessening the concentration of employment in large cities and creating opportunities for work in the less remote rural areas. True, the decentralization of industry is not in itself a source of new employment. There may be no more employment afterward than there was before. But spreading work geographically may spread it in the economic sense, too; it may enable more people to accept half-time jobs. As a means of allaying the pangs of unemployment, that is not to be despised.



### The Main Obstacle

The cash-income problem is a fundamental obstacle. So-called "subsistence farming" will not furnish subsistence; and as the number of families seeking part-time work increases, the difficulty of providing them with the necessary supplementary income increases too. This may be inferred from the results of a survey in Maryland, in 1933, covering 82 part-time farm families in suburban areas and 59 similar families in rural areas. Besides what they raised, the families in the suburban areas purchased food averaging \$369 worth per family; and in addition, they had to pay \$100 more for taxes and house upkeep. Naturally, the suburban families had a much larger income from nonfarm employment than did the rural families. On the other hand, the rural families had lower farm-operating costs; and though their sales were lower also, they averaged only \$20 short of covering the cash expenditures. Most of the rural families produced vegetables and fruits but not in a sufficient variety. As the distance from urban centers increases, it becomes harder to get supplementary income, and in a heavy migration the problem would become insoluble.

### Tenancy Increasing Fast

Underlying most aspects of land planning is the problem of tenure. Without a stable and continuous association with the land, farm operators have little incentive to take care of the soil or to develop cooperative forms of economic and social life. Prosperity, individual or social, consists of two elements: (1) Income, and (2) security in the possession thereof. Farming, which usually earns less money than other occupations, normally is securer. It partially offsets the smallness of the money returns with some assurance that the farmer will not lose his job. In recent years, however, farming as a way of life has lost stability. The proof is seen in the appalling recent increase in farm tenancy; and, as is well-known, farm tenancy is a highly precarious mode of living in the United States. Both the 1925 and the 1930 censuses of agriculture show that less than half of our tenant farmers had occupied their places 2 or more full years. Long-time land planning must include vigorous attention to this problem.

In the half century from 1880 to 1930, the number of farm tenants in the United States more than doubled. The number of tenants among each 1,000 farms increased 136 percent. Forty-two percent of all the farmers in 1930 rented all the land they operated, and an additional 11 percent rented part of their lands. Since then tenancy has increased further, as a result of bankruptcies and foreclosures. In many counties of the South, at the time of the 1930 census, more than half of the farmers were tenants. In some counties, in which the farmers were nearly all whites, three-fifths of the farmers did not own an acre. Less than one-fifth of the farmers in these counties were classed as owners, and even these men were usually carrying mortgages.

It is manifest that such conditions, with their threat to sound farm practice and their discouraging influence on human beings, make



efficient land planning extremely difficult. Tenant farmers in the United States seldom improve the farms they operate, because they usually do not get compensation for their improvements if they have to move. Other countries, notably Great Britain, require landowners to compensate tenants for the improvements they make. Like action here would make tenant occupancy more stable and would protect and improve the farm plant. More security of tenure for tenant farmers would increase their interest in community developments and in other things that depend for their value on a stable association with the land.

### The Beginnings of a Policy

As yet we have made only a beginning in dealing with the tenancy problem. Congress recently amended the Farm Credit Act so as to authorize the Land Bank Commission to make loans for the purchase of land by tenant farmers. A pending measure would create a Farmers' Home Corporation, Government owned and controlled, with a capital stock of \$50,000,000 and authority to issue bonds in an amount not exceeding \$1,000,000,000. This measure, which was introduced by Senator John H. Bankhead and Representative Marvin Jones of Texas, would make it possible to promote the ownership of family-sized, owner-operated farms in quite a different manner from the mere extension of more liberal credit. The bill would set up a national field organization with local subsidiary officers, through which tenant farmers could be aided and directed in becoming owners. The corporation would purchase land and resell it to tenants on a long-time repayment plan under conditions giving the purchasers all the security, opportunity, and incentive of owners. As further study of the land question throws more light upon tenure conditions it should be possible to develop methods which will reconcile the interests of landowners, of tenants, and of the community, and harmonize them with a more scientific utilization of our total land resources.

### WILDLIFE

Land planning must consider wildlife, which is a valuable resource in itself and has claims that we cannot ignore with impunity. Wildlife is a crop. Its production depends on the reservation and development of suitable lands. Failure to provide for wildlife is distinctly bad national economy. Not every piece of land capable of raising agricultural crops should be put to that use as the crops may be worth less than what the land would produce in its natural state. Moreover, the so-called "reclamation" of certain areas by drainage may cause floods, heavy soil erosion, and other damage. Flood control and the prevention of soil erosion may, indeed, depend greatly on the conditions that also favor wildlife and wilderness areas. Land better adapted to wildlife than to farming may actually, if indirectly, support more people if correctly than if incorrectly used. The return to wildlife of land now in agriculture may seem to involve a sacrifice of human interests, but it need not. On the contrary, the economic advantage of protecting fur bearers, game

animals, and birds, and simultaneously of conserving water, soil, and forest resources may be very great.

Wildlife in this country is only a vestige of what it once was; yet even so the return from it to agriculture and industry is probably half a billion dollars annually. We can increase that return substantially by means which also protect other important natural resources. The restoration of wildlife to barren areas requires the planting of vegetation and the protection of water levels. These measures check soil erosion, help to prevent floods, and even mitigate the effects of drought on farming areas nearby. Maintaining vegetation is the best means of conserving soil moisture and preventing soil blowing. The Bureau of Biological Survey conducts a waterfowl-restoration program that illustrates these principles. Besides aiding wildlife to increase, the program helps to correct evils traceable in part to our national mistakes in land utilization. For example, it restores marsh and other submarginal lands to their primitive uses, with the result that poverty competition in agriculture diminishes, the wildlife output increases, trappers and hunters do better, and various industries profit from the sale of trapping and hunting equipment. The land acquires economic value for recreation purposes, and it becomes a national asset for soil conservation and flood control.

### Effects of Unwise Drainage

Heretofore we have dealt with marshland without fully considering the consequences. The drainage ditch has taken away from our waterfowl something like 77,000,000 acres in the continental area of the United States. Some of the land thus reclaimed has become valuable for agriculture, but a great part of it has not. Large acreages have been made useless for wildlife without becoming useful for anything else. Formerly, the marshy valley of the Blitzen River and Lake Malheur in Oregon was one of the most prolific waterfowl areas in the country. Drainage ruined it for waterfowl, and finally drought ruined it for agriculture. The Bureau of Biological Survey is now reflooding and rebuilding the area for wildlife purposes. Within a few years the section will be restored to nature's original purposes and will be producing million-dollar crops of waterfowl and other valuable forms of wildlife. Lake Malheur was a Federal migratory-bird refuge of 80,000 acres before the Bureau began the reflooding project. The addition of nearly 64,720 acres last year, under conditions giving the Government full control of the water, makes it possible to reflood the entire area. This is just one example of many wildlife restoration projects now under way. Funds for the waterfowl-restoration program became available in the latter part of June 1934, and since that time more than 800,000 acres, most of it classified as submarginal, have been acquired for use as waterfowl sanctuaries.

In recognizing that wildlife is entitled to its share of land and water and should have adequate areas for its exclusive use, the Government does not subordinate to wildlife other interests that may be more important. This country has land enough for every need of agriculture, industry, and recreation. We can have wildlife, forest, and wilderness areas, and natural water reservoirs, without encroach-



ing at all on the agricultural and industrial uses of land. It is simply necessary to allocate land among the right uses and to correct the chaos that has resulted from the lack of such a policy in the past. Wildlife is the most valuable product obtainable from many submarginal areas. It is worth far more than it costs. The conservation of fur and game animals, of waterfowl and other birds, and of fish, while important in itself, is also part of farming and of forestry and potentially profitable. Fur and game species may be treated as a crop, and revenue may be derived from the leasing of shooting rights.

### Wildlife in the Land-Use Program

The program for retiring submarginal lands from agriculture gives the Nation an opportunity to return a considerable acreage to its original and best use. In some cases the return of submarginal lands to wildlife will require direction and supervision. In others, noninterference with the habitat and habits of wild animals and birds will suffice. Nature left to her own devices may create more wealth for man than man himself could create in the same areas in agriculture or other occupations. As the land-utilization program develops it should be possible to place under public ownership a number of large tracts for administration as natural wilderness areas. The object is the preservation of the wilderness itself and of the forms of organic life that naturally occupy it. The Migratory Bird Treaty Act of 1918 and the Migratory Bird Conservation Act of 1929 provided for the Federal administration of the migratory-bird resource, and during the year 1932 wildlife refuges were started at strategic points on the waterfowl-breeding grounds or flyways in 21 States, and additional areas are now being examined and acquired. Congress has appropriated \$6,000,000 for this program, which when completed will add another 1,000,000 acres to the area devoted primarily to wildlife.

Big game and all other forms of nonmigratory wildlife are not under Federal jurisdiction, except on lands owned and administered by the Federal Government. All species in this category have diminished greatly and some have even been exterminated where they were formerly abundant. It is the task of the Federal Government to prevent the same disaster on the lands within its control. This is a simple undertaking, in comparison with the difficult and expensive task of restoring marsh and water areas to preserve migratory waterfowl and other forms of aquatic wildlife.

### Biological and Economic Problems Linked

It is extremely important, in framing laws for the preservation and conservation of fur animals, to consider the biological and the economic problems together. Heretofore the length of trapping seasons has been established exclusively in the belief that fur is at its best during extremely cold weather. Other factors should be taken into consideration also. The production of fine-quality fur, under conditions permitting the retention of sufficient breeding stock, requires a correlation between prime fur periods and molt



cycles on the one hand, and breeding and gestation periods on the other. Trapping without regard to these requirements tends to exterminate the fur resource.

Success in the protection of fur animals is not yet assured; yet we have reason to feel encouraged. The beaver, once our most important fur animal, cannot be restored to all its former haunts; but it could be reintroduced in some localities. Besides providing a supply of fur, the beaver would do good as a water conservator along mountain streams, and thus help to prevent floods and erosion, and in some places it would also improve the value of streams and lakes for fishing. This is just one example of the many opportunities that can be developed, through Federal and State cooperation and with the aid of individuals and groups interested in wildlife conservation, to restore a heritage that has been well-nigh lost. Wildlife conservation in the United States is emerging from its period of trial and error and is developing sound practices based on research and experimentation.

## FORESTRY AND ECONOMIC RECOVERY

Forest lands offer a striking example of the American record of land misuse. These lands constitute almost one-third of the area of continental United States. Three-quarters of them—and four-fifths of all the most valuable or commercial forest lands—have long been in private ownership. On these, fires have burned more than 41 million acres annually; ax and fire together have devastated or crippled close to 74 million acres.

Forest empires have been destroyed and sawmills shut down and workers scattered—those left in these empty shells of communities have no market for their labor or the produce of their agriculture. Taxes have become delinquent, and homes and buildings have been abandoned or have been sold for miserable prices. Forest exploitation has left behind it a trail of ghost towns and rural slums, and its effects have soaked deep into the national fabric. With hillsides naked of forests, rains have run off quickly, and floods have been aggravated; the topsoil is eroded from fertile acres; streams, dams, and harbors have been loaded with silt; property has been damaged and human lives lost.

Now, after 150 years of mismanagement, we are attempting to put our forest lands in order. In this tremendous task, people are re-employed; hope replaces despair. Through emergency forest work, forest lands become a vital factor in the fight for recovery.

Our national emergency forest-work program, however, forms part of a comprehensive plan conceived long before the depression; forest projects have been so planned and executed that the work is essentially an investment. It is noncompetitive with industry. Rebuilding men, it contributes to human welfare. Rebuilding forests, it helps lay foundations for permanent economic prosperity.

The Department's Forest Service has taken the lead in the expansion of emergency forest work through the Civilian Conservation Corps, public works, civil works, transient relief, and drought relief. A high percentage of direct labor was employed. The national forests alone, in 37 States, Alaska, and Puerto Rico, furnished more than 26,000,000 man-days of planned work during the year ended June

30, 1934. Preliminary figures for the fiscal year ended June 30, 1935, indicate that the Forest Service planned and supervised a total of work on and outside the national forests in excess of 43,000,000 man-days. Operating in part through State conservation agencies, the Forest Service planned and supervised more than 70 percent of the work projects of the Civilian Conservation Corps. This calendar year, the aim is to nearly double the Civilian Conservation Corps and its work program.

### Relation of Forestry to Agriculture

There are some 495,000,000 acres of commercial forest lands in the United States, directly affecting the economic life of communities. In some regions, successful agriculture can continue only if forest management creates and maintains nearby markets for farm crops. In others, farm population depends on forest work to produce cash incomes, with farm work producing the bulk of the food supply. In many sections, permanent agricultural civilization depends on irrigation—which, in turn, is dependent upon the maintenance of plant cover on the sources of water supply. This, in turn, depends upon forest and range conservation. In still other regions there is the huge task ahead of substituting forest production for agricultural production on worn-out or abandoned farm lands.

Economic and social welfare in many sections is largely dependent upon forest-land forage. Within the continental United States some 334,000,000 acres—more than 50 percent of all commercial and non-commercial forest lands—are grazed by domestic livestock. The western national-forest ranges play an important part in the agricultural economy of large sections. These ranges were used last year by more than 1,400,000 cattle and 6,000,000 sheep; the forage produced on these ranges is essential to the enterprises of some 26,000 stockmen.

For 30 years the national-forest ranges have been under administration as a continuing public resource; on them, drift fences, corrals, and bridges have been built, water supplies developed, roads, trails, and stock driveways constructed, and poisonous plants eradicated. Always the effort has been to issue permits only for the number of stock that the amount and condition of the available forage justified. As a consequence, western national-forest ranges came through 1934 in relatively good condition.

Although the drought relief committee found it necessary to purchase but few of the livestock which grazed on these ranges, the drought had its effect nevertheless. Under the 10-year grazing permits, initiated in 1925, numbers of stock could not, in some instances, be reduced sufficiently or quickly enough successfully to meet range conditions induced by the wide-spread subnormal precipitation that culminated in 1934. As a result, some national-forest ranges, built up prior to 1925 through use under the more flexible annual permits, are not now what they should be. They need rebuilding. Therefore, to obtain a partial rest for the ranges, long-term permits, which expired with the 1934 season, have not been renewed. Grazing permits are again issued on an annual basis. National-forest ranges are being built up so as to contribute to the maximum number of those home units which are dependent for success upon use of national-forest forage.



## Correlation of Land Purchases

Recently, a land policy committee was set up in the Department to meet the need for coordination and correlation of all land-purchase work and to provide for unity of action in other than forest-land purchase programs for such purposes as wildlife refuges, control of soil erosion, curtailment of submarginal farming—programs necessary and advisable in the public interest. The committee acts as a clearing house for all land purchases of all departmental bureaus.

## Forest Research

Forest research is today a vital activity, the essential background of all forest work. The major part of the effort in this field is now concentrated in the Forest Service. Provision is made for basic silvicultural, range, watershed, economics, and products investigations. The current Congress provided for the establishment of a Rocky Mountain Experiment Station, which will constitute the twelfth of a series of regional stations, which, with the Forest Products Laboratory, are intended to cover the forest problems of the entire United States.

The diversity of forest research is illustrated by such current activities as the studies in the construction of inexpensive, modern homes, studies of the condition and weight of cattle as affected by use of range forage, and economic investigations which bring out the wide-spread need for a sounder credit basis for forest production.

Despite the universal use of wood, our per capita consumption of wood fell sharply, even in predepression years; and so, in the face of increased population, did the total consumption. A national timber famine has not yet actually materialized, although since normal forest drain exceeds normal forest growth by a ratio of nearly 2 to 1 (5 to 1 for saw timber), our forest supplies are waning. The need for research and for the development of new uses and markets for wood is evident. But there is also a real need to conserve our forest resources, to add to them by growing forests on all lands most valuable for forest purposes.

## SOIL CONSERVATION

Critical situations in the use of land in any large country may result from causes either economic or physical, or from both together. Land-use problems may arise from overproduction and low prices, or from soil deterioration. Though both types of land crisis diminish the incomes of farmers and reduce the Nation's standard of living, the remedies are not necessarily identical. Crop adjustments may temporarily solve the economic problem without solving the physical problem. Such adjustments, by matching supply to demand, may raise farm earnings; but whether they will also conserve fertility, prevent erosion, and promote good land use depends on the provision they make for intelligent, comprehensive, and sustained action to that end.

There is no necessary contradiction between controlling production on the one hand and building or rebuilding productivity on the other. Nevertheless, it is possible to do the first and neglect the



second, and the mistake may have grave consequences. In long-time agricultural planning the policies which increase current farm incomes should be linked with efforts to protect the physical body of the soil. Coordinated to realize these two ends simultaneously, agricultural planning promotes the interests of consumers equally with those of producers, because, while regulating the volume, it reduces the costs of production. Crop adjustments undertaken without care for the soil lack this necessary feature and may fail to command general approval.

For this reason the Agricultural Adjustment Administration is co-operating with the Soil Conservation Service and with extension workers and farmers in efforts to tie in crop adjustment with soil conservation. It will help us to grasp the significance of this joint effort if we notice some of the physical problems involved.

Some causes of soil depletion may be remedied easily, whereas others may not. Soils protected against erosion may decline steadily in plant food as a result of improper cropping; but in that case the physical body of the soil remains, and frequently fertilizers will restore the plant nutrients. But soil stripped bodily from fields by rain or wind is lost—usually forever. Soil depletion of the first type, through the loss of plant nutrients that can be restored, may make farming temporarily unprofitable; but the second type of soil depletion—erosion—may make farming permanently impossible. Forces that merely reduce the profitableness of agriculture for the time being do not compare in ultimate importance with those that destroy the basic soil resources.

### Physical Aspects of the Present Crisis

That the present crisis in American agriculture has physical as well as economic aspects is now a familiar fact. Recent dust storms, after last year's drought, apprised the whole country of it, and drew attention forcibly to the problem of soil erosion. Formerly we were only dimly aware of the truth that the soil is not an inexhaustible, abundant, and immutable factor in our farm economy and that land exploitation finally must give place to land conservation. Not until the frontier had dissolved into the Pacific did we realize that the opportunity to abandon worn-out land for new was gone. Up to that time we had been imbued with a pioneer psychology that was indifferent to the soil lessons of history and to contemporary practice in other countries.

A physical crisis in agriculture, coming on top of an economic crisis, shook us out of this lethargy, warned us dramatically that our ratio of population to productive land resources is going up, that practically all the better lands have been occupied for agriculture, that much formerly fertile land has been ruined or greatly impoverished, and that considerably more land will go the same way unless we take steps to save it. It may be useful, before describing the soil-conservation work now in progress, to indicate why it is necessary. This takes our story back to the Indians, who did little to change the virgin character of the land surface and its vegetation. In their day rivers draining the densely forested areas generally ran clear except in high flood. Vegetation ranging from grasses to dense forests covered the larger area of the country, pro-

tected the land surface from rainwash and favored the absorption of rain and melting snow. There was little surface washing. Such erosion as did occur was of a geological or normal character and did not exceed the rate of soil formation. Then the white man came with ax and plow and livestock. Advancing rapidly, farmers, lumbermen, and stockmen pushed the frontier farther and farther westward, cleared the land of forests, turned the prairie sod, and overstocked the range. They bared millions of acres to the wash and sweep of rain and wind, and soils which had been thoroughly protected for thousands of years began to erode.

### Types of Erosion

Wind and water are the agents of accelerated erosion. Erosion by water is the more serious evil and is of two major types—sheet erosion and gully erosion. Sheet erosion takes a thin layer of soil, more or less evenly, from entire sloping fields. Its severity usually varies with the degree of slope, the character of the soil, and the type of vegetative cover on the land. It is probably the most widespread form of erosion and at the same time the least noticeable. Farmers usually fail to recognize it until they find their top soil gone. They may even see that their soil is changing in color without realizing that erosion is the cause.

Gully erosion is usually the aftermath of advanced sheet erosion, although it may develop independently as the result of the concentration of run-off water. This concentrated flow of water has sufficient force, especially where sheet erosion has exposed the highly erodible subsoil, to cut rapidly into land. In many sections of the country the resulting gullies have reached an enormous size and have destroyed thousands of acres of land for practical agricultural use.

Wind erosion has always been active on loose sandy soils. Under certain conditions it becomes destructive on fertile loamy soils. Such conditions have been accumulating in this country over a long period. Cultivation and overgrazing, which tend to deplete the humus supply and to pulverize the soil, have exposed vast areas to the sweep of winds across the Great Plains. Dried by several years of drought, small, light particles of soil blow high into the air and drift great distances. Coarser, less productive particles roll along the surface until stopped by some obstruction, and sometimes bury crops, fences, and even buildings. Wind erosion occurs principally within the semiarid sections of the Great Plains where the annual rainfall is less than 25 inches. It is growing serious, however, in other parts of the West, notably in the Big Bend section of Washington and certain areas of the overgrazed western ranges.

Erosion damages not merely the land from which it strips the surface but also bottom lands on which infertile material is deposited. It silts up reservoirs and stream channels, increases flood hazards, and diminishes the water-storage capacity of watersheds. Reservoir silting as a result of erosion is an important problem in many localities. Stream channels shallowed by deposits of erosional debris are far more susceptible to flood. Accelerated run-off from unprotected uplands adds volume to the storm waters flowing into the main drainage stream in the watershed.



It is estimated that erosion costs the United States approximately \$400,000,000 annually in soil depreciation and reduced yields. This figure does not include the damage to navigation, water power, irrigation, and water-supply developments.

### An Erosion Survey

In 1934 the Soil Erosion Service, then in the Department of the Interior and since transferred to the Department of Agriculture under the title of Soil Conservation Service, made a reconnaissance survey of 1,907,000,000 acres representing the total area of the country exclusive of urban and water territory.

On 578,167,670 acres in nearly all parts of the country, the survey indicated little or no erosion of any kind. In an area comprising 857,386,922 acres, sheet erosion was generally prevalent in degrees ranging from slight damage to complete destruction.

Wind erosion had affected a total area of 322,961,231 acres, principally in the middle western States. This aggregate included some 88,000,000 acres seriously damaged or practically ruined for productive purposes.

Gully erosion had caused severe damage generally on approximately 337,000,000 acres, with about 4,000,000 acres so badly cut up as to be unfit for practical cultivation.

Through its Soil Conservation Service, and in close cooperation with the States, the United States Department of Agriculture is directing a national movement to protect and conserve our land from accelerated erosion. It is developing practical and effective methods of control through research and experiment, and is helping to demonstrate these methods under varying conditions. The research phase of the Federal program is carried on at erosion experiment stations in Iowa, Kansas, Missouri, New York, North Carolina, Oklahoma, Pennsylvania, Texas, Washington, and Wisconsin. Demonstrations in practical control are being carried out in cooperation with farmers on selected watershed areas in every major agricultural region of the country where erosion is a serious problem.

Within these demonstration-project areas, through cooperation with landowners and operators, the Soil Conservation Service carries out a complete and carefully balanced program of soil protection, in which the various methods of erosion control are applied singly or in combination according to the peculiar needs and adaptabilities of each type of land requiring treatment. The development of such a coordinated program involves consideration of natural land factors such as climate, land slope, soil formation, and vegetation.

### Practical Control Measures

Practical measures in the control program fall generally into three main categories: (1) Adaptations of thick-growing vegetation to practical farm operations; (2) use of engineering structures, such as terraces and dams; and (3) the retirement of excessively eroded land from cultivation. It is impossible, in dealing with this many-sided problem, to rely in large measure on any single, unsupported method. All available methods, such as correct cropping and rota-



tions, engineering aids, pasture and forest development, and land retirement, must be welded into a composite program of land treatment. Adjusted to the requirements of different kinds of land as determined by soil, slope, rainfall, and the type of farming, the work on the demonstrational areas fits in well with regional and national land-use objectives.

Broadly, the procedure in demonstration areas involves surveys, cooperative agreements, and field work. Each project area is mapped first from the air and then in detail to show the field lay-out of every individual farm, the location of fences, wooded areas, streams, and other physical features. With these maps as a basis, field workers of the service and the farmer together draw up practical plans for the stabilization of all eroded areas. These plans, which may call for a considerable reorganization of farming practices, become the basis for cooperative 5-year contracts between the farmers and the Government.

## COTTON

Three crops of cotton have now been produced in the United States under Agricultural Adjustment Administration adjustment programs, and the administration has offered new contracts to cotton growers covering a 4-year period beginning with the crop of 1936. These programs have fulfilled their purpose, which was to prevent the continued overproduction of cotton. The program in 1933 removed from production about 10,500,000 acres. In 1934 and 1935 the programs withheld, respectively, about 14,600,000 acres and 14,000,000 acres from production. Each program reduced the world carry-over of American cotton. At the end of the 1934-35 season the carry-over totaled about 9,000,000 bales, as compared with about 13,000,000 bales on August 1, 1932. Yet the carry-over was still far above predepression levels.

Cotton prices have risen greatly in the period covered by the adjustment programs. In the 1934-35 season the average farm price was 12.4 cents a pound, as compared with 6.5 cents during the 1932-33 season. The 1934-35 average price was 79 percent of parity. At their lowest point in 1932, cotton prices were only 37 percent of parity. Farm income from cotton and cottonseed, including rental and benefit payments, was \$839,000,000 in 1934-35 and \$862,000,000 in 1933-34. In 1932-33, the season preceding Agricultural Adjustment Administration crop adjustment, the return was only \$464,000,000. Present indications are that the figures for 1935-36 will show a still further increase, constituting the largest gross income from cotton and cottonseed since 1930.

It may be useful briefly to describe the adjustment machinery. Under the Agricultural Adjustment Act, the administration enters into contracts with growers providing for rental and benefit payments in return for specific adjustments in their acreage. Supplementing the contracts is the Bankhead Cotton Act of 1934, which imposes a heavy tax on the ginning of cotton produced above the allotments. In addition, the Commodity Credit Corporation makes loans available to cooperating producers. In the 1933-34 season the loan value was 10 cents a pound. This was increased to 12 cents in the 1934-35 season. In 1935 the Agricultural Adjustment Adminis-

tration announced a modification of the cotton-loan plan. The loan value was reduced to 10 cents and, a new feature added to the loan agreement whereby producers who agreed to cooperate in crop adjustments during the 1936-37 season will receive adjustment payments equal to the amount by which 12 cents exceeds the average price of Middling  $\frac{7}{8}$ -inch cotton in 10 designated spot markets on the date on which the producer sells his cotton. This adjustment is limited to 2 cents a pound and does not apply to cotton produced in excess of allotments under the Bankhead Act.

### The Cotton Loans

Large numbers of growers obtained loans in 1933-34 and 1934-35. In the 1933-34 season the market price of cotton advanced well above the 10-cent loan value, and the loans were largely liquidated. Toward the end of the 1934-35 season, however, the market price of cotton tended to fall below the loan value, which as already noted had been raised to 12 cents a pound. The result was that by the end of the year the Government was holding about 4,500,000 bales as loan collateral. It had extended the maturity date of the loans to January 1, 1936. Stocks of Government-financed cotton constituted practically the entire surplus stock. Stock in trade channels and in mills had been reduced to normal or subnormal levels. It was extremely desirable to move the accumulated stocks into export and into domestic consumption. Reduction of the loan rate to 10 cents a pound promoted that end, with cooperating growers protected by the adjustment payments previously mentioned.

Rental and benefit payments to cooperating cotton growers totaled \$112,600,000 in 1933-34 and \$115,800,000 in 1934-35. In 1935-36 the rental and benefit payments will amount to probably \$125,000,000. Taxes collected on the first domestic processing of cotton largely defrayed the costs of the adjustment programs without adding materially to the retail prices of cotton goods. On an average, for the three seasons during which the crop adjustments have been in effect, the farm prices of cotton plus the rental and benefit payments have approximately equaled parity or fair-exchange value as defined in the Agricultural Adjustment Act so far as the domestically consumed portion of the crop is concerned.

Enactment of the Bankhead Act in 1934 followed a questionnaire survey which indicated that most growers favored the principle involved. In 1935 the administration took a referendum to determine whether the growers wished to continue with that method. About 90 percent of those voting favored doing so. Accordingly, operation of the Bankhead Act was continued for the 1935-36 season. There is no doubt that the provision for taxing cotton produced above allotments increased the effectiveness of the cotton programs in 1934 and 1935. Furthermore, the system provided cotton growers in drought-stricken areas with a certain amount of crop insurance. They had the privilege of selling their unused exemption certificates to other growers at the rate of 4 cents a pound of cotton, or of retaining the certificates for use the following year. Most growers whose production exceeded their allotments purchased exemption certificates, in preference to paying the ginning tax, the rate of which



was 0.67 cent a pound, with the result that approximately \$13,800,000 was distributed to growers in Texas and Oklahoma through a national pool organized to provide facilities for the transfer of tax-exemption certificates. Ginning taxes collected during the first year of the Bankhead Act amounted only to \$1,123,524.

### Need for Continuing Adjustment

There is evident need to continue the cotton-adjustment program. The carry-over of American cotton at the end of the current season will be far above normal, and a return to unrestricted production would mean a return to low prices. With growers planning their production independently instead of in concert, our cotton production could easily increase to 15,000,000 or 16,000,000 bales annually. In only three seasons has the world used more than 15,000,000 bales of American cotton, and these were seasons of exceptional business activity at home and abroad, during which, moreover, the United States was financing our exports through loans. It is highly desirable to increase our sales of American cotton abroad, but we may do that for some time without increasing our production. Our accumulated stocks, with adjusted production, give us the means of supplying all probable demands.

Certain long-time factors in the cotton situation, with which the Agricultural Adjustment Administration programs have nothing to do, should be borne in mind. Though the total consumption of cotton has increased in foreign countries during the last 25 years, the exports and the foreign consumption of American cotton have been barely maintained. Indeed this country exported more cotton in the 5-year period ended with the fiscal year 1914 than in any subsequent 5-year period. For 40 years the production of cotton has increased somewhat more rapidly in foreign countries than in the United States. Nationalistic policies in many countries have accentuated the trend. An important factor is the increasing industrialization of the Orient and the development there of cotton spinning and weaving. Oriental countries that formerly imported cotton goods from the United States and Europe are now large exporters of such goods; and the raw material they use is mostly non-American cotton. The large use of foreign cottons in the Orient results partly from the nearness of the mills to the producing areas and partly from the fact that foreign cotton growers have the advantage of cheaper labor. These differentials tend to offset the relatively high waste and stoppage loss in the spinning of foreign cottons. Moreover, many foreign cotton-producing countries have devalued their money more than the United States has devalued the dollar, and cotton prices have responded to a greater extent than most other agricultural prices. This has brought additional land into cotton production.

### Foreign Trade Should Not Be Sacrificed

It does not follow that we have lost our foreign markets for cotton irrecoverably or that the United States should adjust itself to a domestic-production basis. But the time has not come for abandoning the cotton-adjustment programs. As we know from the con-



tinued presence of surplus stocks in this country, the United States has not reduced its power to supply the foreign demand. The 12-cent loan probably held back exports for a time, but the modified loan program will correct that tendency. American cotton is the standard in world trade and offers the largest even-running quantities. The potential demand for American cotton is large in Europe, in Canada, and in the Orient, and a well-considered adjustment program will not sacrifice it. It is important not to restrict production too drastically and not to forget that price is only one of the factors in farm income. Cotton farmers should not produce at a loss, in order to maintain the Nation's exports; but neither should they underestimate their ability to compete with foreign growers.

## WHEAT

Commencing during the crop year 1933, approximately 800,000 farm operators and landlords have participated in an effort to apply the principle of cooperative action to the adjustment of wheat production. The fact that 1,328 wheat-production-control associations have been organized and that farmers have been successful in performing the local administrative functions is now well known throughout the agricultural sections of the country.

Since 1933 the wheat surplus has been reduced, prices in the United States have maintained levels substantially above world prices, and the cash income received by wheat producers, including adjustment payments for the 1934 crop, was practically double the cash income for the crop of 1932. Farmers have demonstrated their ability to cooperate in an effort of this kind and have given their endorsement to a continuation of the program.

Although the principal proportion of the reduction in the surplus was caused by the drought of 1933 and 1934, the wheat program provided means for making a much larger adjustment than was necessary under existing conditions. Thus, the wheat-adjustment program has demonstrated its practical application during three most unusual seasons. The plan lends itself to upward as well as downward adjustments and permits changes in the adjustment policy to meet changing physical and economic conditions.

The wheat-allotment contract, approved in the summer of 1933, provided for a maximum downward adjustment of 20 percent in wheat seedlings. Because of the drought of 1933 and 1934 and the rust epidemic of July 1935, adjustments of this magnitude were not warranted, and consequently the required adjustments for the crops of 1934, 1935, and 1936 have been 15, 10, and 5 percent, respectively. Furthermore, the requirements as to use of contracted or adjusted acreage were modified so as to offset in part the shortage of livestock feed occasioned by the drought.

On July 31, 1935, it was announced that a 15-percent reduction would be required in seedlings in the 1935-36 crop year. At that time the available data based on the July crop report indicated a wheat crop for 1935 of 731,000,000 bushels, which would have provided a substantial surplus from the 1935-36 crop year, and would in all probability have resulted in an increase in the carry-over on July 1, 1936, as compared with that on July 1, 1935. When the August

crop report was published, however, it was discovered that the spring wheat crop had been damaged as a result of one of the most severe rust epidemics in history. This materially changed the prospective wheat situation. In view of this changed situation, planting requirements for 1936 were modified so that a downward adjustment of only 5 percent from the base was required in the 1935-36 crop year.

### Consumers' Interests Considered

By means of these changes in adjustment requirements, consumers have been protected by ample supplies of wheat. The carry-over of wheat on July 1, 1935, was 152,000,000 bushels, which is about 27,000,000 bushels larger than the average for the period 1920-28. The operation of the wheat-adjustment program contemplates an acreage in the United States which, over a period of years, will produce a substantial surplus above domestic requirements.

The interest of consumers is protected under the wheat-adjustment program not only in the assurance of adequate supplies, but also in assurance against excessively high prices. Under this plan the processing tax is adjusted upward or downward in accordance with the difference between the average farm price and the wheat-parity price. The parity price is based upon pre-war purchasing power of wheat in terms of the cost of commodities farmers buy, interest on farm indebtedness, and taxes on farm real estate. Thus, the cost of wheat to the miller is stabilized at or near the parity price. With parity at \$1.10 to \$1.15 per bushel, the processor pays no more for his raw material when the price of wheat is \$1 than he does when the price is 50 cents. This stabilizes the cost of wheat and should have an equally stabilizing effect upon the cost of bread.

Experience has also shown that the principles embodied in the wheat-adjustment program will permit the United States to maintain a substantial volume of export trade. Short crops in 1933, 1934, and 1935 have made substantial reductions in the amount of United States wheat available for export. In all of these crop years, however, some export trade has been secured. Total exports of wheat and flour amounted to 21,532,000 bushels during the 1934-35 crop year, as compared with 37,001,000 bushels during 1933-34 and 41,211,000 bushels during 1932-33. Under the wheat-adjustment program, when normal yields are obtained and the United States has a surplus, our wheat will be sold in such a manner as to meet competition in the markets of the world. Anticipated plantings for the 1936 crop will, with normal yields, result in at least 75,000,000 or 100,000,000 bushels for export, and a similar amount would have been available in 1935 had it not been for the dust storms and the rust epidemic.

### World Wheat Situation

The world wheat situation is characterized by continued tariff and import restrictions which maintain acreage and production in importing countries at relatively high levels. These policies tend to cause the world trade in wheat to prevail at lower levels than the relatively large volume of international trade which characterized the 1920's. Under present conditions a total volume of world ship-



ments greatly in excess of 600,000,000 bushels does not appear probable during the next few years. The present level of production in exporting countries will produce a surplus somewhat in excess of the anticipated import requirements. The United States stands ready to cooperate with other nations in bringing about an adjustment of world production to demand. It is believed that an effective international wheat agreement will be hastened if this country continues to produce a sufficient amount of wheat so as to remain an active participant in world trade. In furtherance of this policy, plans for 1936 have been modified so as to permit the production of an exportable surplus of wheat in addition to increasing domestic reserves.

### The Wheat Price Outlook

Until world-wide adjustments in wheat production have been made, the price of wheat to farmers in the United States will in all probability prevail at levels below the parity price. Under these conditions the income to wheat producers in the absence of adjustment payments would be less than their equitable share of the national income. Under such circumstances wheat producers will benefit from adherence to the principles of the wheat-adjustment program, which provides them a measure of income insurance and maintains their purchasing power at levels substantially higher than would otherwise prevail. The attitude of wheat producers is evidenced in their overwhelming endorsement of the principles of the wheat-adjustment program in the wheat referendum which was held on May 25, 1935.

In looking to the future of agricultural adjustment as it applies to wheat in the United States, attention needs to be given to the problems of different wheat-producing regions. There are four major wheat-producing regions in the United States; namely, the soft red winter wheat region, the hard red winter wheat region, the hard red spring and durum wheat region, and the white wheat region of the Inter-mountain and Pacific Coast States. The production of hard red spring and soft red winter wheats has approached a domestic basis for a number of years, whereas exportable surpluses have arisen primarily in the case of white and hard red winter wheats. The regions producing these types of wheat, however, appear to have a comparative advantage for wheat which has caused farmers in these regions to maintain their acreage in the face of declining prices. The various classes of wheat are interchangeable in a large degree, and in view of this interchangeability and comparative advantage in surplus-producing regions, no feasible method has as yet been devised for providing for different adjustments in different regions. This problem is receiving the attention of the Department of Agriculture and the land-grant colleges and requires the careful consideration and study of wheat producers generally.

### THE LIVESTOCK SITUATION

Livestock production is recovering slowly from the 1934 drought, but the country's meat supply will be subnormal for another year or two. It takes time to replace breeding stock, the foundation of the annual meat supply; and it takes still more time for the progeny



to be raised and fattened. The number of livestock on farms on January 1, 1935, was the smallest since early in the present century. The shortage resulted directly from the drought, which tremendously reduced pasturage and grain and hay crops. Livestock numbers would have been even smaller this year, had the Agricultural Adjustment Administration not acted last year to prevent excessive liquidation, and to make the liquidation that was inevitable as orderly as possible. Hog farrowings in the fall of 1934 were only about half those of the fall of 1933, and the spring farrowings in 1935 were less than two-thirds as large as those in the spring of 1933. The 1934 and 1935 corn-hog adjustment program had no appreciable effect on these farrowings, the smallness of which was the result primarily of the drought.

Government action undertaken in 1934 and early in 1935 for the relief of the cattle industry conserved foundation stock. The Government purchased more than 8,000,000 cattle and turned over to the Federal Surplus Relief Corporation all animals fit for human consumption. This action mitigated the effects of the drought in two ways: (1) It increased the supply of meat available for 1934, because otherwise many of the animals would never have reached slaughter houses; and (2) the purchase program reduced death losses on farms and ranches and enabled growers to save breeding stock. Cattle slaughter under Federal inspection in 1934 was the largest since 1926. Had the Government not furnished a market outlet, cattle prices would have declined to a point that would scarcely have paid marketing costs. Large numbers of cattle in the drought areas could not have been sold, and death losses would have been vastly greater. Besides conserving meat supplies, current and prospective, the cattle-purchase program increased the income of the cattle producers. Gross returns to cattlemen in 1934, including \$112,000,000 paid by the Government for drought cattle, were probably 75 percent greater than they would have been otherwise.

Meat production depends in the long run on the feed available; but after heavy reduction in livestock numbers, the limiting factor temporarily is the time required for breeding and rearing. It is necessary to keep the feed supply in balance with the rate of increase in livestock numbers. The 1934 corn crop was the smallest since 1894, and was less than half the pre-war average. This year's corn production on the other hand is large in relation to the reduced feeding demand. According to the September estimate, it was about 2,184,000,000 bushels. Though nearly 400,000,000 bushels below the average for the years 1928-32, the crop will provide the largest supply per hog on farms January 1 since the World War. Moreover, the supply of other feed grains and of forage will be ample likewise. All told, the grain supply per grain-consuming animal will be as large as in any year since the war, and the supply of hay available per hay-consuming animal will be the largest of any year, with one exception, during the same period. Any greater increase in feed production would have simply depressed feed prices without immediately increasing the supply of meat.

### Adjustments Lessened Drought Effects

Crop-adjustment contracts entered into by farmers lessened the bad effects of the drought last year and facilitated a return to more normal production this year. Thus in 1934, when the drought became serious, the Administration authorized plantings of late-sown feed and forage crops on land under contract and permitted contract signers to plant corn for forage on contracted acreage. These steps increased the production of feed materially. The supply of late-sown crops, such as soybeans, was larger than in the previous year. The spring pig crop in 1934 was smaller than it would have been had farmers not entered into adjustment contracts; and this fact, too, helped to promote an orderly liquidation of hog numbers when the feed shortage became acute. The emergency reduction of hog supplies in the fall of 1933, with the 1933-34 corn-loan program, had resulted in the carrying over of some 50,000,000 bushels of corn and corresponding amounts of other feeds from the 1933 crop. Thus the feed supply per animal unit was larger than it would have been had the control programs not been undertaken.

In 1935 the Administration offered to farmers a corn-hog program which restricted the planting of corn but not the planting of other feed crops. Also the Administration made a supply of adapted seed available to producers in drought areas. As a result, the acreage of oats, barley, and grain sorghums increased 10 percent above the 1928-32 average. Yields were only slightly below normal, and the production of these grains was 5 percent above the 1928-32 average, and two and one-half times as large as in 1934. The contract called for a reduction in the corn acreage for two reasons. In the first place, the number of grain-consuming animals on the farms was the smallest in 35 years; and in the second place, the usual farm practice of planting more corn acreage in years following droughts would have resulted, with average yields, in a corn supply far in excess of feeding requirements. Adjustments made by the contract signers held corn production more nearly in line with livestock needs.

Under the 1935 corn-hog contract, the individual farmer had to retire from corn production not less than 10 percent nor more than 30 percent of his base corn acreage. The benefit payment was 35 cents a bushel for the appraised corn yield. Signers retired in the aggregate 23 percent of their base corn acreage, or nearly 12,000,000 acres. About 93,000,000 acres of corn was harvested, as compared with the 1928-32 average of nearly 103,000,000 acres. As already mentioned, the yield was only slightly below the average, and the supply of corn per hog on farms is now the largest since the war. Without a corn-acreage limitation, the 1935 corn crop would have created a burdensome surplus. The production might have equaled 2,800,000,000 bushels, and the supply of corn per grain-consuming animal would have been much greater than in any other post-war year.



### Corn Adjustment Necessary in 1936

Some adjustment in the corn acreage should be made again in 1936, if the supply of corn is to be kept in line with feeding requirements. On a harvested acreage equal to that of 1935, average yields would provide a supply of corn per grain-consuming animal equal to that of any year since the World War. Average yields on an unadjusted acreage would give a supply much in excess of feeding requirements. There is feed enough on hand and in prospect for next year, assuming average yields, for materially increased hog production. Just now there is a shortage of hogs; and a marked increase in hog production is desirable. Care should be taken, nevertheless, to prevent the upswing from going too far. Exports of American hog products annually since the World War have declined by the equivalent of 8,000,000 head. The increase in the domestic population partly offsets this decline in the foreign demand, but a supply of hogs as large as the post-war average would carry hog prices down far below parity. Recovery from the effects of the drought requires continuous crop adjustment rather than a return to unrestricted production.

### DAIRY PRODUCTS

Prices of dairy products have been much higher in the last 2 years than they were in 1932 and early in 1933. In fact, the general trend has been upward since March 1933, in which month the farm-price average was only 71 percent of the pre-war level as compared with 157 percent in 1929. For the second half of 1933 the average was 91 percent of pre-war; for the second half of 1934 it was 100 percent. The average for the first 4 months of 1935 was 116 percent of the pre-war level. There was a recession during the summer; and for the months June to August, inclusive, the average was 98 percent of pre-war.

Several factors contributed to the uptrend. Demand conditions improved in 1933, marketing agreements and licenses under the Agricultural Adjustment Act exerted a steadying influence, and Government purchases of dairy products for relief distribution removed stocks from trade channels. Dairy conditions were still unfavorable at the beginning of 1934. Though milk production per cow had dropped to the lowest point in 8 years, the total milk production was not much below the peak of 102.3 billion pounds reached in 1933; and the number of milk cows in the country as of January 1, 1934, was 17.3 percent greater than it was 5 years previously. However, the drought of 1934 changed matters greatly, and dairy production dropped off.

Government purchases of drought cattle, heavy liquidation of cattle numbers in the ordinary channels of trade, and the Federal program for the eradication of cattle diseases brought about a decrease of 4 percent in milk-cow numbers in the second half of 1934. Moreover, pasture conditions were so poor and feed supplies so short that milk production per cow declined to the lowest point touched in 11 years. This drop in production, though it carried the total for the year down only to 3.3 percent below 1933, added another strong influ-



ence to the factors already operating for price recovery. The shortage of feed supplies other than pasture held milk production relatively low in the winter of 1934 and the spring of 1935, in which period the output of butter in particular was down. Part of the major butter-producing region had been hard hit by the drought.

Pasture conditions improved in 1935, and milk production per cow increased substantially. During most of the pasture season total milk production was 4 or 5 percent greater than in 1934. It should be kept in mind that, notwithstanding the moderate decrease that took place in milk-cow numbers in 1934, the productive capacity of the dairy industry is still very large in relation to the demand. Animals eliminated from herds in 1934 were mostly low producers, and their elimination had only a minor effect on total production capacity. Fairly liberal supplies of roughage and of other feeds are in prospect now, and numbers of other farm livestock are much reduced. Therefore, the production of milk in the next year or two may exceed the large outturn of 1933. Such an increase in milk production would tend to offset the influence of the improved demand and to depress returns to producers.

### Government Purchases of Dairy Products

In 1933 leaders in the dairy industry urged Government purchasing of dairy products to remove surpluses from commercial channels and undertook to support a production-adjustment program. The Government began purchasing in August 1933 and by April 1934 had bought 45,769,000 pounds of butter and 6,346,000 pounds of cheese. It purchased additional quantities later with funds provided under the Jones-Connally Cattle Act. From May 1, 1934, to April 30, 1935, the quantities purchased were as follows: Butter, 16,176,000 pounds; cheese, 11,574,000 pounds; evaporated milk, 37,596,000 pounds; and dry skim milk, 6,526,000 pounds. From May 1 to November 8, 1935, contracts were awarded for the following amounts: Butter, 7,064,000; cheese, 194,000; evaporated milk, 9,431,000; and dry skim milk, 9,322,000. Deliveries on the latter quantities have not been completed. These products were all distributed through relief channels. In accordance with the plan for an adjustment program, the Agricultural Adjustment Administration in April 1934 offered a program involving benefit payments for cooperative adjustments in dairy production, but dairymen appeared to be about equally divided for and against it. It is the policy of the administration not to proceed with any adjustment program without the support of a substantial majority of the interested producers. Accordingly, the dairy program was withdrawn, and the industry continued to rely on marketing agreements, which deal of course only with the existing supply of milk and milk products. Indications are that the need for more fundamental adjustments still exists.

### Small Danger of Significant Imports

There is little prospect of developing important foreign outlets for our dairy products. In recent years the industry has been practically on a domestic basis; and dairy prices in the United States are far above dairy prices in the major butter-importing countries. It is not likely that trade negotiations can overcome an obstacle of this character. In fact, with dairy production increasing in other countries there is a possibility of imports into the United States. Thus, in the first half of 1935, domestic butter prices went for a time above foreign prices by more than the amount of our tariff, which is 14 cents a pound, and 21,487,000 pounds of butter came in over the tariff barrier. However, butter imports for the 3 months, July to September, dropped to 448,000 pounds, and we exported 244,000 pounds. At the current level of world prices, the level of prices in the United States could rise substantially above that of the summer of 1935 without attracting any significant volume of imports.

### TOBACCO

For about 375,000 farmers in 28 Southern and Eastern States the principal sources of cash income is tobacco. Usually the production of tobacco in the United States is about 1,400,000,000 pounds, about 40 percent of which is exported. This total production is made up of several distinctly different kinds, each grown in a particular section of the country. Flue-cured tobacco and burley tobacco are the most important kinds; about 60 percent of the former normally is exported; nearly all of the latter is consumed domestically.

Beginning in 1930, the consumption of tobacco declined both at home and abroad. Our exports dropped, and large surpluses accumulated. Tobacco prices fell to very low levels. In 1931 the tobacco crop was about as large as that of 1929; yet it brought the growers only \$130,000,000, as compared with \$286,000,000 from the 1929 crop. The crop of 1932 was the smallest in several years; and though growers received a higher average price than that for the 1931 crop, the farm value of the 1932 crop was only \$107,800,000, or 60 percent less than the value of the 1929 crop. This was the situation for which Congress provided remedies in the Agricultural Adjustment Act.

When this act was passed the growing season for most kinds of tobacco was so far advanced that it was not practicable to bring about adjustments in the 1933 production except in the case of the cigar-leaf types, which are planted later in the season than other types. Other procedures under the act, however, were used to improve the situation which tobacco growers faced.

When the flue-cured tobacco markets opened in 1933, prices fell so low that growers demanded the temporary closing of the markets. After growers signified a willingness to adjust the production of succeeding years, the Administration negotiated a marketing agreement with the principal buyers whereby they agreed to purchase certain quantities of the 1933 crop at or above a specified price. Similar agreements were arranged for burley, fire-cured, and dark air-cured tobacco when growers gave assurance that supplies would be



adjusted in succeeding years. As a result, growers received 65 per cent more for the 1933 tobacco crop than they did for the 1932 crop.

In 1934 the Agricultural Adjustment Administration entered into adjustment contracts with approximately 275,000 growers in continental United States and 10,500 growers in Puerto Rico. The contracts covered about 88 percent of the land on which tobacco is usually grown. The resulting adjustment in tobacco production reduced the excess stocks on hand by about one-third. The surplus of flue-cured tobacco was eliminated; supplies of other types, however, were still excessive, particularly those of burley and cigar-leaf tobacco.

### Producers' Income From Tobacco

Income to producers from tobacco in 1934 was more than double that of 1932, not including benefit payments. With benefit payments amounting to \$43,136,000 included, the total income from the 1934 crop was \$266,315,000, as compared with a 10-year average (1919-28) of \$270,602,000. The total return gave the growers a purchasing power exceeding the 10-year average by 25 percent.

The 1934 contracts were continued in 1935, and growers who had not signed contracts received another opportunity to do so before planting their crop. Also, the Administration provided special base contracts for growers who had previously produced tobacco but who could not establish bases in the ordinary way. These special base contracts took into consideration the personal production history of the growers, as well as their land, labor supply, and other producing facilities.

The 1935 crop is estimated at 1,120,000,000 pounds, as compared with 1,046,000,000 pounds in 1934, and an average of 1,433,000,000 pounds for the 5 years 1928-32. The flue-cured crop is about 25 percent larger than it was in 1934, and above the 5-year average. Consumption of this type, however, is increasing, both in the United States and in the United Kingdom, and the crop is not out of line with requirements. The burley, fire-cured, and dark air-cured crops are about the same as in 1934, and substantially below the 5-year average. But for these types the market outlook is less encouraging. Burley tobacco, about 95 percent of which is consumed domestically, is not so well adjusted to the demand as some of the types more dependent on exports. Shifts in consumption and international trade restrictions continue to affect the markets for fire-cured and dark air-cured tobacco. Production of cigar-leaf tobacco in 1935, though somewhat larger than in 1934, was less than half the 5-year average; but the consumption of this type is very low, and the surplus is still large. The need for adjustments in tobacco production is a continuing one.

In response to the requests of growers, Congress passed the Kerr Tobacco Act, which was approved June 28, 1934. The act levied a tax of 33½ percent of the gross sale value of all tobacco harvested in the crop year 1934-35 except Maryland, Virginia sun-cured, and cigar-leaf tobacco, but authorized a tax rate of not less than 25

percent if the lower rate would accomplish the desired end. For the 1934 crop the minimum rate was in effect.

Producers operating under adjustment contracts received tax-payment warrants with which to pay the tax. Similar warrants in limited amounts were issued to noncontracting growers in each county who were unable to obtain equitable allotments under contract. After the passage of the Kerr Act, growers were given another opportunity to sign contracts, and many did so.

### Referendum on Kerr Act

In December 1934 and January 1935 the Administration took a referendum to see if the growers favored a tax on the sale of tobacco for the crop year beginning May 1, 1935, as provided in the Kerr Tobacco Act. The returns covered more than 90 percent of the acreage customarily devoted to tobacco. Approximately 90 percent of the growers of the flue-cured, fire-cured, dark air-cured, and cigar-filler and binder types favored the tax. Accordingly, it became effective for the 1935 crop, this time at the full rate authorized in the legislation.

All the original tobacco contracts terminated with the 1935 crop; and in July the Agricultural Adjustment Administration conducted a referendum to determine whether the growers desired another program. All landlords, tenants, and share-croppers were invited to vote. Nearly 75 percent of the growers eligible to vote did so; and more than 95 percent of those voting favored continuing the program. After the referendum, Agricultural Adjustment Administration representatives conferred with advisory committees of tobacco growers regarding the principles and details of proposed new contracts.

On July 29 a program was announced for flue-cured tobacco, the kind marketed earliest in the year. In effect the new program continues, for the 4 years 1936 to 1939, the program that was in force for the crop years 1934 and 1935, but contains new features. The principal changes are in providing for more equitable distribution of allotments among individual growers and greater simplification of the contract and administrative procedure. Similar contracts are being prepared for other types of tobacco.

In the recent amendments to the Agricultural Adjustment Act, Congress fixed the processing taxes on tobacco at the rates then in effect. Provision was made, however, for certain changes to correspond with changes in tobacco prices. Specifically, the amendments prescribe that if the average price for tobacco during the 2 months immediately preceding a marketing year and the first 10 months of that year is less than the fair exchange value by not more than 10 percent, or exceeds the fair exchange value by 10 percent or less, the rate of tax shall be adjusted at the beginning of the next marketing year to 20 percent of the fair exchange value. Should the average price exceed the fair exchange value by more than 10 but not more than 20 percent, the rate must be adjusted to 15 percent of the fair exchange value. If the average price exceeds the fair exchange value by more than 20 percent, the rate must be adjusted to 10 percent of the fair exchange value.



### Changes in Processing Taxes

In accordance with these provisions, adjustments were made in the processing taxes on tobacco, effective October 1, 1935, as follows: For Burley tobacco used in the manufacture of products other than chewing, the rate was reduced from 6.1 cents per pound, farm-sales weight, to 3.5 cents per pound; the rate for Maryland tobacco was increased from zero to 3.62 cents per pound, farm-sales weight; for fire-cured tobacco the rate was increased from 2 to 2.14 cents per pound for that used in chewing tobacco and was reduced from 2.9 to 2.14 cents per pound for that used in other products; and for flue-cured the rate was reduced from 4.2 cents per pound, generally, and from 2 cents per pound for tobacco used in the manufacture of chewing tobacco, to 1.89 cents per pound, farm-sales weight, for all uses.

After investigation and hearings it was determined that the full processing-tax rates provided for cigar-leaf tobacco generally, for cigar-leaf tobacco used in the manufacture of scrap chewing, and/or smoking tobacco, and for Burley tobacco used in the manufacture of chewing tobacco, would cause such a reduction in the quantity of these kinds of tobacco or the products thereof domestically consumed as to result in the accumulation of surplus stocks or in the depression of the farm price of these kinds of tobacco. It was found that the rates previously in effect were the highest rates that could be levied without having such results. Accordingly, these rates were made effective October 1.

The average price for the 1934 crop of dark air-cured tobacco was less than fair exchange value by more than 10 percent. The processing tax for dark air-cured, therefore, remained at the rates in effect at the time of passage of the amendments to the Agricultural Adjustment Act.

### SUGAR

Substantial progress has been made in the complex program of adjustment of sugar supplies to requirements. The sugar problem differs in several respects from that of most of our other basic agricultural commodities. A sugar-beet and sugar-cane industry of considerable importance in certain areas of the country has become established mainly as the result of tariff protection. Three-fourths of the sugar we consume is produced outside of the continental United States. A large part of this production is in our own insular possessions or Territories or Cuba, with which producing area we have had special trade relations.

In the formulation of an adjustment program for the sugar industry it was necessary to protect the right of our domestic producers to an appropriate share of the United States sugar market in a manner to yield the producer the maximum benefit, impose the minimum cost on the consumer, and at the same time enable the United States to deal fairly and satisfactorily with her insular areas and foreign countries supplying the United States market.

Before the enactment of the Jones-Costigan amendment to the Agricultural Adjustment Act, the protective tariff was the traditional and sole device used to protect the interests of domestic sugar producers. The tariff, however, was not effective in maintaining returns to growers. Our insular areas operating behind the protection of a high tariff, increased their production and in their effort to displace a large portion of the duty-paying Cuban sugar in the United States market, competition was intensified.

The sugar program made possible by the Jones-Costigan amendment seeks to assure for domestic producers a fair share of the domestic market through a quota system, and to supplement the income of producers by benefit payments for their cooperation in adjusting production. In addition, adjustments by producers in our insular areas are compensated by benefit payments.

During the year and a half that the sugar plan has been in effect surplus sugars in the continental United States and insular areas have been eliminated. Adjustments in production have been made in the domestic sugar areas as well as in the principal United States insular areas supplying sugar to this country. The principal curtailment of surplus was in the Philippine Islands, where Philippine planters were confronted with a substantial adjustment of production in view of the Philippine Independence Act. That act provides for a limitation of duty-free importations of sugar into the United States to 956,000 short tons annually. Through cooperation with the adjustment program, Philippine planters were able to receive adjustment payments to aid them in making the transition to a lower level of production required by the independence act. Continental and offshore supplies have been brought into closer balance with consumption requirements with resultant strengthening of price.

### General Results of the Program

The income of producers generally has increased, and in those localities of the United States sugar-beet area where the 1934 drought drastically reduced production, benefit payments under the sugar-beet program were of unusual importance in maintaining farmers' income. These results have been achieved without materially increasing the cost to consumers. Returns to laborers in the beet fields have been increased directly through wage determinations by the Secretary of Agriculture, and in other sugar-producing areas provisions protecting laborers have been included in the production-adjustment contracts. Positive action toward the elimination of child labor in the sugar fields has been taken. Compliance with child-labor restrictions and wage and labor provisions of the farmers' contracts with the Government is a prerequisite to benefit payments.

Quotas were established as outlined in the act. Minimum annual marketing quotas of 1,550,000 short tons of sugar for the domestic beet-sugar industry and 260,000 tons of sugar for the domestic sugarcane industry were established. The quotas for the offshore areas were based upon their average shipments to the continental United States during the 3 "most representative years" of the period 1925-33, in accordance with the provisions of the act. In view of



the quotas established in the act the domestic beet-sugar producers have in effect, in their production-adjustment program, agreed to produce at a stabilized level in return for the added income which the quota provisions of the act and benefit payments make possible. The basic quota of 1,550,000 tons for beet sugar is higher than the marketings of any previous year and higher than the production of any year except the record year 1933. In comparison with past production, the quota is substantially above the average for the 9 years 1925-33, although 12 percent below the high year 1933. The domestic sugarcane basic quota of 260,000 tons is higher than the production in any year of the 1925-33 period.

### 70,000 Producers Cooperating

Through the mechanism of production-adjustment contracts approximately 70,000 producers are cooperating in the sugar-beet program. The goal of the production is a production approximately equivalent to the national beet-sugar marketing quota. Despite the extreme drought 1934 sugar-beet income of farmers, including benefit payments, amounted to nearly \$57,000,000, slightly higher than that from the record 1933 crop. Louisiana producers signed approximately 9,000 adjustment contracts, and under the program their 1934 cash income was approximately \$16,000,000 as compared with \$11,000,000 in 1933. The sugar producers of Florida and sugarcane sirup producers also have derived benefits from the act under separate programs developed for them.

In the insular areas similar adjustment programs have been put into effect. The 1934-35 Philippine sugar production was reduced from an estimated 1,571,000 short tons to 694,000 short tons in order to absorb in 1935 the 400,000 tons carry-over from the 1933-34 Philippine crop. Philippine production for the crop year 1935-36 will approximate 1,100,000 short tons. Benefits to about 19,000 Philippine producers for reducing production during the 1934-35 crop year and maintaining production during the 1935-36 crop year to the quantity necessary to produce its United States quota, provide for local consumption requirements, and maintain its 100,000 tons emergency reserve will be approximately \$16,000,000. In Puerto Rico contracts were entered into with about 8,000 producers. In the aggregate production of sugar has been reduced by approximately 313,000 tons as compared with the record crop of 1933-34. The curtailment was brought about without destruction of cane by utilizing a considerable part of the excess cane for conversion into molasses for distillation and feedstuffs purposes, and by reducing plantings to about one-third of normal and carrying over surplus cane into the new crop year in replacement of such deficiencies in planting. It is anticipated that a total of \$12,000,000 will be disbursed as benefit payments on the 1934-35 crop. In Hawaii a 3-year program is in effect seeking to stabilize production at about 975,000 tons annually. Adjustment payments are estimated at \$8,750,000 annually.

## Expenditures From Special Funds

In addition to benefit payments the insular areas have received benefits under the sugar-adjustment programs by various expenditures for the benefit of agriculture out of special funds created under the Agricultural Adjustment Act for that purpose.

Pursuant to section 15 (f) of the act as amended, the President has established separate funds in which are held processing taxes collected on the sugars from the various areas, which funds are to be used for the general benefit of agriculture in the respective areas. Up to date projects have been approved for Puerto Rico and Hawaii, including soil surveys, insect-pest surveys and control, tropical-plant experiments, erosion work, and similar purposes.

As a result of the quotas and the tariff reductions made on Cuban sugar in 1934 under provisions of the Tariff Act of 1930 and the Trade Agreement with Cuba of 1934, the cost and freight price for Cuban sugar sold to the United States has increased by about 70 percent and our trade with that area increased markedly after the sugar program and the reciprocal trade agreement with Cuba became effective in September 1934. During the first 11 months of this agreement trade between Cuba and the United States increased 60 percent.

The processing tax of one-half cent a pound which finances the sugar program has not increased the cost of sugar to the consumer, since the imposition of the tax was accompanied by a reduction in the tariff of an equal amount.

## RICE

Rice is a basic commodity under the original form of the Agricultural Adjustment Act, but the Administration did not immediately launch a production-adjustment program financed by processing taxes for this commodity. Instead it undertook in 1933 to adjust supplies and promote higher prices through marketing agreements. This course seemed advisable, because the rice industry is relatively small and geographically compact and because in the California area the growers and millers had had previous cooperative experience. However, rice is grown also in a group of Southern States—Arkansas, Louisiana, and Texas. Conditions in the California rice area differ greatly from conditions in the southern area, and the marketing-agreement method proved better adapted to the former than to the latter area. In both areas the agreements helped to control production and raise prices to growers, but certain difficulties developed in the southern area which indicated that a production program financed through processing taxes would be more satisfactory. Accordingly, under an amendment to the Agricultural Adjustment Act, the Administration offered to growers a control program based on a processing tax and benefit payments for 1935-36.

The first marketing agreements entered into provided for minimum prices to growers and minimum conversion charges to millers for the sale of rough rice. They became effective in the autumn of 1933. The California agreement contained also an acreage-control feature, and subsequently a like feature was incorporated into



the southern agreement. In California all the millers and practically all the growers agreed to the production-control plan, the mechanics of which involved the retention of part of the agreed price, for distribution later to growers, on proof that they had fulfilled their obligations. In the southern area, on the other hand, a minority of the rice millers declined to cooperate. It became necessary, therefore, to issue a license to all millers, but the license did not contain provisions for production control. The nonsignatory millers, according to the terms of the license, had to pay producers the full price for their rice at the time of purchase. There were noncooperative producers, as well as millers, in the southern area. These noncooperators were able to get more for their rice from nonsignatory mills than cooperating producers could get immediately from signatory mills. The resulting difficulty caused signatory millers to doubt the value of the program, and in September 1934 it became necessary to modify the production-control mechanism, the vital feature of which was the arrangement for differential payments as between cooperating and noncooperating growers. In March 1935 the Administration terminated the southern marketing agreement and shortly afterward announced plans for a program similar to those in effect for other basic crops.

### Results of the Marketing Agreements

The marketing agreements achieved much for the growers, despite the difficulties encountered in the southern area. They kept acreage in check in the face of rising prices. The price of domestic rice advanced well above world levels and, indeed, made temporarily an excellent market for Philippine rice, which may enter the United States duty free. The acreage actually planted approximated the allotments, and the resulting production approximated the quotas originally assigned. The production of rice in 1934 was 38,296,000 bushels, or only 4,212,000 bushels above the aggregate of the quotas.

Some evidence of the effectiveness of the agreements appears in a comparison of rice prices in recent years. Extra Fancy California-Japan at San Francisco, in 1934-35 was \$3.78 per hundred pounds, as compared with \$2.40 in 1932-33. Extra Fancy Blue Rose at New Orleans was \$3.75 per hundred pounds in 1934-35, as against \$2.25 in 1932-33. The farm price of all grades and varieties of the 1934-35 crop averaged nearly twice as much as that of the 1932-33 crop. The total farm value of rice in 1934, according to the crop estimates of December 1934, was \$29,662,000,000, as compared with \$16,116,000 in 1932.

Special provisions for rice adjustment under a processing tax-benefit payment plan are contained in the DeRouen rice bill, which was enacted March 18, 1935, as an amendment to the Agricultural Adjustment Act. This measure authorizes a processing tax at the rate of 1 cent a pound for rough rice, effective April 1, 1935, until July 31, 1936. It exempts clean rice from the provisions for floor stocks taxes. It provides for tax-payment warrants in payment of the processing tax on rough rice of the 1933 and 1934 crops purchased under the previous marketing agreements and licenses. In addition, the bill sets up machinery to export surpluses of rice from

the 1933-34 crop under conditions permitting the maintenance of domestic prices.

The program launched under this legislation eliminates most of the difficulties experienced under the marketing agreements. Under the processing-tax feature it puts all mills on the same basis with respect to the purchase of rice; and by imposing a compensating tax on rice imports, it prevents imports of Philippine rice except at levels comparable with domestic prices. Rice produced in this country can again be exported, at least in quantities sufficient to prevent the accumulation of surpluses. The program provides for an export rebate equivalent to the processing tax paid; and the exports for the 3 months following April 1, when the processing tax became effective, amounted to 76,000,000 pounds, as compared with 18,000,000 pounds in the corresponding period last year.

## POULTRY AND EGGS

The poultry and egg industry is one of the most important branches of agriculture. In 1934 its products brought a gross income of \$653,932,000, and this return was exceeded only by the income from milk and cattle and calves. The 1930 census reports nearly 5,500,000 farms, or approximately 5 out of every 6 farms in the United States, as producing poultry and eggs; and 76.9 percent of these farms have flocks of less than 100 fowls. The fact that it is made up of such small units makes difficult the solution of the industry's problems by adjusted or controlled production.

Many thousands of handlers are engaged in collecting, processing, and shipping poultry products for use locally as well as to more distant markets. The interstate aspects of this trade made it possible, under the National Recovery Act, to develop codes of fair competition with certain branches of the industry, under the dual administration of the National Recovery Administration and the Agricultural Adjustment Administration. Several marketing groups, including the baby-chick-hatchery group, submitted codes for consideration. Conferences and hearings followed. On January 2, 1934, the Commercial and Breeder Hatchery Code became operative; and on April 23, 1934, a code became operative for the live-poultry industry of the metropolitan area of New York. Considerable work was done to develop regional codes with other marketing branches of the industry, but these codes were never completed.

The Commercial and Breeder Hatchery Code was Nation-wide in effect and involved between 12,000 and 14,000 producers of baby chicks and chick dealers. It was in operation during two hatchery seasons, and benefited the poultry industry generally as well as the hatchery industry. The giving of secret rebates, failure to deliver chicks as agreed, substitution of chicks without the buyer's knowledge or consent, false and misleading advertising, and various forms of misrepresentation were to a great degree eliminated.

### Poultry-Improvement Plan

As originally approved the code contained a mandatory provision requiring the code authority to develop, in cooperation with this Department and other interested agencies, uniform terms, rules, and



regulations for flock improvement. Such a program was submitted to and approved by this Department and is now in operation. This is known as "the national poultry-improvement plan", the purpose of which is to create a uniform basis and terminology for flock improvement, and similarly, a uniform terminology and program for disease control as relating to chicks.

The hatchery industry has taken advantage of an offer by the Federal Trade Commission to aid in continuing the progress made through the code with respect to fair-trade practices. It has revived and put into effect trade rules which have the approval of that Commission.

In 1934 the estimated wholesale value of the products handled by the live-poultry industry of the metropolitan area of New York was \$27,647,367, and such products were shipped to New York from 31 States. In the period, a little over a year, during which the live-poultry code was operative, it accomplished an estimated annual saving of over \$100,000 to shippers of live poultry through reduction of coop and cartage costs. Also, it served to stabilize the live-poultry market in New York by requiring a report of expected shipments, by continuing the official inspection of live poultry, and by correcting objectionable and unfair trade practices. The *Schechter case*, which involved violations of this code, was selected by the National Recovery Board as a test case before the United States Supreme Court to determine the validity of certain portions of the National Recovery Act. As a result of the decision in this case, all codes were declared invalid.

Since poultry and eggs were not included as basic commodities under the Agricultural Adjustment Act, the only method open to the administration at present for assisting in the problems of this industry is through the use of marketing agreements. Before entering into such agreements, it will first be necessary to study the essential economic facts. Such a study is now under way, and it will furnish a guide in formulating future policies.

## RYE

The recently approved amendments to the Agricultural Adjustment Act called for a production control program for rye. Accordingly, the Administration held public hearings at Aberdeen, S. Dak., August 29, 1935, and at Washington, D. C., September 6, 1935, at which farmers and others testified regarding the present and prospective price of rye and regarding features of the proposed program. The amendments provided for a processing tax of 30 cents a bushel on rye, and this rate will be effective from September 1, 1935, until December 31, 1937, unless it is modified in harmony with a specific formula set forth in the legislation. Rye regulations issued by the Secretary established conversion factors for determining the amount of processing tax to be imposed on different rye products. Included in the regulations was a statement calling attention to the marketing years as fixed in the amendments to the Agricultural Adjustment Act, the first marketing year being from September 1, 1935, to June 30, 1936, and subsequent marketing years from July 1 to June 30.

Rye production in the United States in 1935 was estimated as of August 1, at 52,200,000 bushels, or about 20,000,000 bushels above

the average annual domestic consumption. In 1934 the production was only 16,040,000 bushels; the 5-year average (1929-33) was 35,167,000 bushels. With an export surplus in prospect, an adjustment program was considered necessary to establish a balance between the production and consumption of rye and to restore the commodity to fair exchange value. As of August 15, 1935, the estimated average farm price of rye was 35.5 cents a bushel. Fair exchange value on that date was 92.9 cents a bushel. In 1934-35, when rye was on an import basis, the farm price averaged about 75 cents a bushel. The depressing influence of the season's exportable surplus is reflected in the present wide disparity between farm prices and the fair exchange value.

The rye program will run parallel with the new wheat contract. Cooperating producers will limit their rye acreage for harvest as grain in accordance with the requirements of domestic and foreign markets, but in no year may they be required to reduce their acreage harvested as grain below 75 percent of their acreage of rye harvested as grain in the base period. Allotments to individual farmers will depend on acreage and yields in the base period but in addition will be subject to modification in accordance with definite regulations. This flexibility in the determination of individual allotments should help farmers who have recently begun to produce rye. The advance payment in 1936 will be at the rate of 20 cents a bushel on farmers' allotments, and the total 1936 payments will be at least 35 cents a bushel on the farm allotments, unless rye prices should rapidly rise and approach parity. The administration of the program will be decentralized as much as possible through local machinery already established for wheat adjustment.

## RESEARCH

The principal function of this Department is scientific research. All its other activities, such as weather and crop reporting, the eradication or control of plant and animal diseases and pests, the administration of regulatory laws, highway construction, and economic guidance, are the practical expression of research results. Research is the primary thing, the keystone of the entire structure of the Department's functions and services. Naturally the Department does not rely exclusively on the findings of its own investigators; on the contrary, it draws upon the general fund of scientific knowledge as it increases throughout the world. But this is one of the tests of its scientific efficiency and value. Were the Department not engaged itself in creative scientific work, it could not use creatively the findings of other institutions. Only science can assimilate science.

All-pervasive as research obviously is in the sum of the Department's activities, we may yet fail to grasp this fact in its full meaning. This may happen if, for theoretical convenience, we separate the work into watertight compartments, and strike off boundary lines that have no counterpart in nature. Commonly, for example, we think of science as restricted to chemistry, physics, and biology, and exclude from it certain problems in economics, politics, and sociology. We distinguish improperly between the exact and the inexact studies. There is really a difference only of degree. Science, we say, has given



us the means of plenty, and now social organization must show us how to use this instrument. Actually, science has not given us the means of plenty until it has solved the economic and social as well as the technical difficulties involved. The field of science is social as well as technical and includes the human application as well as the discovery of scientific facts and principles. The scope of science is life as a whole, and not just certain limited aspects of life.

Agricultural science furnishes many illustrations of the principle. Research has developed many new uses for farm byproducts, the commercial development of which often requires large-scale operations for a wide demand. Practical benefit depends, therefore, on the collaboration of the production specialist and the chemist with the industrialist and the industrialist with the consumer. Chemical discoveries in refrigeration, in the preservation of fruits and vegetables by heat treatment, and in canning affect types of farming, the geographical distribution of farm enterprises, and the national dietary. Economic research discloses the powers and limitations of controlled marketing and controlled production and shapes national adjustment policy. Research in livestock diseases, besides directly safeguarding the public health, influences medical thought and medical practice. Discoveries in animal nutrition have a bearing on human nutrition. As technology increases productivity, it compels attention to the distribution of products. The chemical analysis of foods and drugs is the primary means of food and drug law enforcement. Weather studies furnish warnings against floods and frosts and safeguard navigation and aviation. Single discoveries in science form part of a mosaic or pattern, the design of which is quite as important as the separate discoveries. Science is a living thing fashioned of many elements, each standing in a dynamic relationship to the whole and having no meaning apart from its place in the pattern. After the analysis of problems, by separate study, there must be a synthesis of the results, a synthesis which tends to grow wider and more comprehensive as the need develops for conceiving the application in terms of social welfare.

Research in this Department and in the agricultural experiment stations and land-grant colleges has been conducted for many years with these principles in mind. The research has developed structurally and functionally in adaptation to the continually changing environment. Certain difficulties, however, have tended to hamper free and full coordination of projects and to discourage certain basic studies. One drawback has been the allocation of research funds item by item, on a bureau basis, for objects sharply particularized. Under this system the research has been developed largely to meet emergencies, to throw up quick defenses against animal and plant pests and diseases, to solve specific economic questions, or to develop varieties or strains of plants and livestock suited to particular conditions. Research of this type, for objects well defined in advance, is extremely valuable, and will always be necessary. But it is not the only type of research which agriculture needs. In fact, such research is in the nature of superstructure. It needs much more foundation research to establish laws and principles. Science is exploration and should not be confined to territory that can be mapped in advance. One might as well equip an exploration party and forbid it to break new ground.

### New Legislation for Research

As a step toward remedying this situation, Congress passed an act, which was approved June 29, 1935, making special provision for basic research in the Department, and in the agricultural experiment stations and land-grant colleges. The measure, now known as the Bankhead-Jones Act, also provides for the further development of agricultural extension work. Title I of the act authorizes and directs the Secretary of Agriculture to conduct scientific, technical, economic, and other research into laws and principles underlying basic problems of agriculture in its broadest aspects, and also authorizes and directs him to conduct research to improve the quality of agricultural commodities, to develop new and improved methods for their production and distribution, to discover uses for farm products and byproducts and manufactures thereof, and to study the conservation, development, and use of land and water resources for agricultural purposes.

For the purposes of title I, the act authorizes the appropriation of \$1,000,000 for the fiscal year beginning July 1, 1935, and for each of the 4 fiscal years thereafter \$1,000,000 more than the amount authorized for the preceding fiscal year, and \$5,000,000 for each fiscal year thereafter. This money is for work in addition to, and not in substitution for, research or other activities provided for otherwise. Forty percent of the money is for expenditure directly by this Department, and the remaining 60 percent for allotment among the States and Alaska, Hawaii, and Puerto Rico. Not to exceed 2 percent of the total may be used in administering the 60 percent available for the States and Territories.

Under title II the measure authorizes appropriations for the further development of the cooperative-extension system in the several States and the Territory of Hawaii. For this purpose it authorizes an appropriation of \$8,000,000 for the fiscal year beginning July 1, 1935, and for each fiscal year thereafter an additional \$1,000,000 until the total reaches \$12,000,000 annually. This money will be distributed in a manner similar to that governing appropriations under the Smith-Lever Act of May 8, 1914, with the exception that the allotments will be made on the basis of farm population rather than of rural population, and with the further exception that the States and Hawaii need not match the Federal funds. Title II also authorizes additional appropriations for the land-grant colleges—\$980,000 for the fiscal year beginning July 1, 1935, and the same amount for each year thereafter. This sum is to be divided equally among the several States and Hawaii. The same title authorizes \$980,000 more for the colleges for the fiscal year beginning July 1, 1936, to be distributed to the States and Hawaii in equal shares, and \$500,000 more each year thereafter until the additional amount reaches \$1,500,000 annually. These latter sums are to be paid to each of the States and to Hawaii in the proportion which the population of each bears to the total population of all the States and the Territory of Hawaii. The maximum total for the land-grant colleges will, therefore, be \$2,480,000.



## Practical Aspects of Basic Investigations

In thus appropriating funds for basic research, in addition to funds for the study of highly specific problems, Congress recognized that fundamental research may often be more practical than short-cut research. Scientific history abounds with examples. Experimenters formerly attempted to control certain potato diseases by changing the time of planting the crop, by trying to keep the seed from "running out", and by adopting special methods of cultivation and fertilization. Fundamental research proved finally that filterable viruses could cause disease in plants. That one fundamental discovery furnished the basic knowledge for rational solutions of the problems of many diseases, not only in potatoes and other plants but in animals and human beings. Permanent solutions of many of these problems have been developed.

Certain fundamental studies at agricultural experiment stations and elsewhere have disclosed some of the effects of rations derived from various plant sources and have led to exact knowledge about vitamins. This in turn answered many specific farm problems, such as the real difference in feeding values of white and yellow corn, the value of pasturing livestock, the value of well-cured hay, and other problems which had been perplexing investigators.

Fundamental research into the chemical make-up of fats, sugars, and proteins showed why certain things serve as foods and to some extent why they are good foods or poor. Investigations in the chemical constitution of proteins revealed that they consist of a small number of comparatively simple substances joined together. These substances are called amino acids. Digestion breaks down the proteins into amino acids, which the animal body absorbs and rebuilds into proteins. Hence the food value of a protein depends upon how easily digestion breaks it down, and into what amino acids it is resolved. It has been demonstrated that some of the amino acids are essential to the health of the animal while others are not. With this knowledge it becomes possible to define with more scientific accuracy what is a proper food. Studies in the conversion of sugar into alcohol by fermentation reveal that the process may be modified to yield glycerin instead. Glycerin is a necessity in war, and its production from sugar influenced the course of the World War 20 years ago. It is a truism, however, that the value of scientific knowledge depends on the use we make of it; and the progress of science doubtless promotes more good will than ill will among the nations.

## Weather Forecasting

Long-range weather forecasting is a basic problem which should be more studied. Meteorological data are available from many stations located in the larger land areas as well as from many more or less isolated islands. Investigators have found weather relations in some cases direct and in others inverse between points widely separated on the earth's surface, and there is every indication that these are bound up in some way with the general circulation of the atmosphere. It appears, too, that the so-called centers of action or

semipermanent areas of high and low pressure change their positions and intensities from time to time. The shift in position may be so marked that certain regions which normally are within a high-pressure area may change to a low-pressure area or may change from one side of a low- or high-pressure area to the opposite side. The result is to change the character of the weather from hot to cold or from dry to wet. Meteorologists believe it would be fruitful to determine whether these changes of position and intensity of the centers of action can be related to changes in the temperature of the ocean, changes in the polar icecaps, or changes in solar activity, as well as whether a change in the position and intensity of one center of action is followed by changes in other centers. There is something in common in the weather in widely separated parts of the earth, even in countries on opposite sides of the globe. Changes in rainfall in central North America show a general similarity to changes in central South America. Changes in pressure in southern South America during September, October, and November show a general relationship with the subsequent May to September monsoon rainfall in India. Such relationships are undoubtedly associated with the general circulation of the atmosphere and the behavior of the so-called "centers of action." Thorough investigation of such associations as they affect the weather in the United States would be profitable. Foreknowledge of the weather, such as would make it possible, for example, to predict droughts, would obviously be of enormous practical value, not merely in revealing factors which control variations in crop yields but in the regulation of all kinds of economic activities.

Fragmentary and piecemeal research in problems which are essentially basic almost necessarily yields disappointing results. Plant breeders, for example, may develop a sugarcane that resists mosaic disease, only to find that the new strain falls an easy prey to diseases that the older varieties resist. It is obviously necessary to study the fundamental nature of resistance to disease. Entomologists, under the pressure of emergency demands, may try to discover an insecticide that will kill a particular moth and save a particular crop, and the effort may be worth while. It may be still more important, however, to reveal the habits and physiology of insects in general, so that the control problem can be dealt with broadly as it applies to many insect pests. Fundamental chemical research on the properties of insecticides may solve many insect-control problems simultaneously. Research for limited, so-called practical objects often fails, until scientists widen the scope of their inquiry to include the basic elements involved and so reveal the governing laws. In this way they discovered that resistance to disease is a genetic character, the factors for which may be inherited. This discovery has already borne much fruit and ultimately will mean more than innumerable attacks on specific plant diseases.

### Main Goals In Basic Research

As knowledge widens, it touches the unknown at more points and raises new problems; and it is easy to pose more questions than can be solved. The fact that we glimpse a big problem is not in itself a sufficient warrant for spending time and money in an effort to solve



it. There should be a fair chance of progress. Authority for this Department to conduct research without being required to tell in detail what it expects to find, does not justify aimless wandering or imply that a sense of direction is unnecessary. Fundamental research need not be less practical than research for concrete specified advantages, though we may be unable to foresee just where it will lead. The analogy with geographical exploration is apt. Explorers do not strike out into a void but into territory which they want to know better. Similarly, the scientific investigator has a general idea of the continent he wishes to map, and perhaps also a rough notion as to its main contours. He may not move straight to a defined objective; but the method of fundamental research is not impractical merely because it may be indirect. On the contrary, the indirect approach may be the better way, just as it is better to catch fish indirectly with rod and line rather than directly with bare hands. Heretofore, the endowed scientific institutions such as the great foundations and some of the universities have been freer to conduct research of this character than have public agencies. Increased fundamental research in the Federal and State agencies is timely, and in full accord with the principle that these public institutions should be prepared to keep our basic knowledge abreast of our need in meeting definite human problems.

### The Trace-Elements Problem

An example of a practical question that is truly basic is the role of the various chemical elements in plant growth. Both animals and plants contain in their structures, in varying quantities, practically all the known chemical elements, and it may even be that all these elements are essential. Scientists no longer believe, as they did until quite recently, that only 10 elements are necessary to crops and that application of the 3 important elements, nitrogen, phosphorus, and potassium will solve most fertility problems. They have discovered that magnesium, iron, or sulphur are lacking in some soils and that in some regions certain of the less common elements such as boron, iodine, copper, or manganese may not be present in quantity sufficient for proper plant nutrition. Even less common elements, such as chromium, strontium, titanium, and caesium, may have functions in plant growth. A deficiency of certain elements in the soil may mean the difference between profitable and unprofitable farming, or between desirable and undesirable products. An excess of a given element such as boron or selenium may prove to be decidedly harmful. It is imperative to know what elements are important in plant nutrition; for a shortage in the soil means a lack in the plant, and consequently in the livestock that feed on the plant. This is believed to have important effects on human nutrition.

Investigation of the so-called trace elements in foods would begin with a soil or medium of known chemical constituents, and continue with studies in nutrition. The task would require the cooperation of agronomists, chemists, and animal husbandmen. It would call for experiments in the production of food plants under controlled conditions, so as to determine how they behave on different soils. Investigators would observe the effect of the presence or absence of elements

such as calcium, iron, copper, iodine, fluorine, and boron on growth, yield, and reproduction. Likewise, they would study the influence of elements known to be often detrimental, such as selenium, fluorine, and boron. Some experiments would require an abundance, others a shortage, and still others an entire lack of a particular element in the soil. The next step would be the feeding of experimental animals. Food material obtained under the controlled conditions would give results measurable in animal metabolism, growth, glandular activity, and disease conditions.

### The Role of Enzymes

Much remains to be learned about enzymes—the ferments produced by the vital activities of living cells. Study of their action as it appears in the cellular processes of respiration and metabolism, oxidation and hydrolysis is essential to the solution of many agricultural and industrial problems. Among these problems are the utilization of enzymes in food, beverage, chemical, and other industries; the destruction of the enzymes that cause agricultural products to spoil, the function of enzymes in the curing of hay and the fermenting of silage; the employment of enzymes in the analysis of agricultural products; and the preparation of enzymes for medicinal use. The generally important result to be expected from enzyme chemistry is the explanation of many physiological processes, as mysterious now as was digestion—an enzyme process—a hundred years ago. Very lately the mechanisms of fermentation and respiration have been partly worked out in this way.

Research in the Department has dealt already with some aspects of the role of enzymes, as, for example, the deterioration of stored eggs and the fermenting of dough for breadmaking. Other problems in which enzymes seem to play a significant part have been little studied. What substances in sweetclover inhibit the blood-clotting mechanism and cause animals to become bleeders when fed sweetclover hay? What relation, if any, have enzymic processes to the premature sterility of livestock? What are the enzymic reactions that constitute the processes of ripening in fruits, in grains, and in meats? These are typical questions about enzymes, the answers to which would be tremendously useful, but which cannot be answered without more fundamental research.

### Genetics

The development of superior plants and animals through breeding is one of the great achievements of American agriculture. Although progress in the science of genetics has been exceedingly rapid since the rediscovery of Mendelism in 1900, progress in the art of breeding has been relatively slow. This is particularly true in animal breeding, where the value of individual units is very high and reproduction is relatively slow. Nevertheless, livestock breeders have relied increasingly on the science of genetics and as a result they have abandoned many false doctrines and eliminated much unnecessary work. Yet there remains entirely too much guesswork in the prevailing breeding practices, and there is great need for additional research in genetics



and related fields, particularly in regard to the nature and inheritance of animal characters of economic value.

Much research in genetics has been done with organisms of little economic value such as *Oenothera*, *Datura*, *Drosophila*, etc. Although this work has been invaluable in establishing certain laws of inheritance, its practical value depends on the application of these laws in the production of agriculturally important plants and animals. Progress in genetics since 1900 has demonstrated such fundamental concepts as the occurrence of linkage groups and the futility of selection within pure lines. If the art of breeding is to be materially improved, however, it is necessary to have more basic information on such matters as the mode of inheritance of important characters, the nature of resistance in plants and animals to disease and insects, linkage groups, and the cause of exceptional vigor in hybrid strains.

Perhaps much of this needed information can best be supplied by better coordination of research effort, similar to that which has produced such exceptional results with corn. In 1928 corn geneticists initiated a systematic study in which each of the 10 chromosomes of corn was assigned to workers in different institutions. This coordination of effort has eliminated much possible duplication and has speeded up the research program to a remarkable extent. Similar cooperation for other economic plants and for certain kinds of livestock is highly desirable as fundamental research in genetics is pressed forward.

### Chemical Photosynthesis

In chemical investigations the photosynthesis of plant substances furnishes an outstanding example of a fundamental problem, which, to be sure, is inherently very difficult. Nevertheless, basic research in it may lead indirectly, in ways not now foreseen, to important agricultural and industrial results. Through the radiant energy of the sun, plants transform carbon dioxide and water, with the aid of a chlorophyll and other related pigments, into carbohydrate material. This is the primary product of photosynthesis. Subsequent transformations convert the first product into fats, proteins, terpenes, alkaloids, flavors, and pigments, which are in the widest daily use. Chlorophyll is the most important coloring matter in the vegetable kingdom, and the role of chlorophyll in photosynthesis is still largely unknown. It takes approximately 100,000 calories of energy to produce an ounce of sugar from carbon dioxide and water, and yet plants produce many ounces. We do not know how they perform this miracle, nor how they operate their factories without using enormous pressures, high temperatures, expensive chemicals, and elaborate equipment. This mystery shrouds the basic problems of all life on the earth. Other phases of photosynthesis which deserve consideration are the effect of light on ripening processes, on the chemistry of seed germination, on the development of color in flowers, on rancidity in food products, and on vitamin-containing products such as ergosterol.

### Research In Farm Economics

Besides authorizing additional basic research, the new law provides, as already noted, for research regarding the production, distribution, and consumption of agricultural commodities. In other words, it authorizes the study of essential elements in farm adjustment. This is largely a problem in the coordination of research procedures and research findings, a task necessarily difficult under the itemized project method whereby different governmental bureaus with separate funds and separate projects operate more or less independently. The new legislation affords the Secretary greater opportunity to organize a joint attack on this and similar problems—to bring the soil chemist, the agronomist, the animal and dairy husbandman, the agricultural engineer, and the economist into a more effective collaboration on problems within the scope of the act. The coordination of different studies is often essential in basic investigations, and yet difficult with funds appropriated for highly specialized work. Sometimes, for example, the problem seems to be quite definitely in the field of chemistry, as in one case where certain stains in wood seemed to be of chemical origin. Later the stains proved to be due to an organism. It was then necessary to enlist the cooperation of the biologist. Many problems require the cooperation of chemists, physicists, and bacteriologists before their fundamental nature can be revealed. The necessary coordination of studies should be facilitated under the new law.

### Flexibility In Procedure

Still another advantage of the new law is the flexibility it authorizes in research procedure. Heretofore, the Department has had only limited authority to shape or change the course of its investigations in accordance with changing requirements. Facts learned in the course of an investigation may open new possibilities, or even suggest the abandonment of projects as they were originally conceived. Knowledge gained in one field may greatly influence studies in another. Rigid procedures, which make small allowance for this fact, and which permit no change in the marching orders, are very hampering. With all research funds appropriated item by item, more than a year must pass after research plans are made before the funds become available. Another delay occurs if circumstances necessitate a change of plans. This lack of elasticity in the shaping of research programs sometimes frustrates their purpose. Generally the method of itemized appropriation works well. Research projects do not need to be changed radically very often. The exceptional cases, however, may be extremely important. It may sometimes be vital to conduct an investigation uninterrupted, even if an important change in its direction becomes advisable. Henceforth it will be easier for the Department to meet such exigencies. On approval in writing by the Secretary, funds provided for special research in this Department under the new law may be made available for the prosecution of research previously instituted or for the prosecution of new research. In short, the legislation authorizes a flexible attack on research problems and permits the Department to reshape old projects and to initiate new ones as occasion may require.



## ANIMAL INDUSTRY

Recent contributions of research and the application of veterinary science have exerted a steady influence on stock raising and agriculture. The hog raiser, for instance, who immunizes his herd against hog cholera and who also uses the system of swine sanitation developed by the Department, operates under a better and safer economic system than was possible before research provided these forms of protection. Ability to control stomach worms, scab mites, and other parasites of sheep likewise have placed the production of that class of livestock on a more secure basis. Still further results of coordinated research and its application have been industrial developments such as the manufacture of biological products, dips, and disinfectants.

In the breeding of domestic livestock the Department has made available to livestock owners knowledge of Mendelian inheritance and other basic breeding principles. Supplementing former studies showing the greater utility value of improved livestock over ordinary types, the Department has conducted record-of-performance investigations with the principal species of domestic animals. Individual beef steers of different breeding have required from as little as 373 days to as many as 533 to reach a finished weight of 900 pounds. In the case of other animals, data on the rate of gain have shown similar variations that may be attributed to inherited characteristics. Since rapid development of animals contributes to profits in stock raising, record-of-performance studies are a means of identifying breeding animals of superior merit.

### Bovine Tuberculosis Reduced to 0.6 Percent

An outstanding achievement in establishing healthy foundation herds of cattle has been the extensive aggressive campaign against tuberculosis. Through the detection and slaughter of diseased cattle, including beef as well as dairy types, cooperating Federal and State officials not only have checked the spread of this disease but have reduced its average degree of prevalence from 4 percent in 1922 to 0.6 percent in 1935. This is the most extensive veterinary field campaign conducted in any country at any time.

In the face of much doubt as to the feasibility of the undertaking because of the vast numbers of cattle, their extensive interstate shipment, their constant perpetuation by breeding, the expense of the campaign, and the problem of obtaining a sufficient number of trained inspectors, this work, begun in 1917, progressed steadily until 1934. At that time it received renewed impetus through funds made available by the Agricultural Adjustment Administration. In the spring of 1935 nearly 100,000 cattle were being tuberculin-tested daily. Systematic testing of all cattle in 73 percent of the counties in the United States, together with the removal of animals found to be tuberculous, has already been accomplished. An all-time record in volume was set during the fiscal year 1935, when more than 25,000,000 cattle were tuberculin-tested.

From both public-health and agricultural viewpoints it is noteworthy that tuberculosis eradication, since the beginning of the

cooperative campaign, has resulted in the detection and slaughter of more than 3,000,000 tuberculous animals. The cooperation received from livestock owners has been highly satisfactory in almost all the localities where the work has been conducted. The emergency funds allotted by the Agricultural Adjustment Administration have hastened this work materially in certain States. Such funds made it possible to pay indemnity to owners of reactors in cases where no State payment could be made because of lack of State funds or lack of authority to pay under the State law.

Thus the work has extended into many States where it could not have been done with the means provided for the regular tuberculosis work. The total payment that the owner received for his reactors from all sources did not exceed, however, the amount he would have received if the payment had been made from regular Federal and State funds.

### Department Helps Cattle Owners Combat Bang's Disease

Within the last year the Department has likewise satisfied the appeals of dairymen, in particular, and cattlemen, in general, for assistance in suppressing the costly and insidious malady known as Bang's disease or infectious abortion. In the past this disease has taken a toll from the livestock industry estimated at \$50,000,000 a year. The infection not only caused death of calves and impaired production in the herd, but was a serious handicap in the sale of breeding stock. Many States have restrictions against the entry of animals from infected herds. A further disturbing element was the close relationship between Bang's disease in cattle and undulant fever in man. Considerable evidence indicates that raw milk from a herd so infected may transmit the organism, *Brucella abortus*, from cattle to man.

### Federal Aid In Controlling Mastitis

As a further step toward a more effective control of animal diseases, the Department has undertaken, as a part of the emergency program in behalf of agriculture, to aid cattle owners in suppressing mastitis, an udder disease affecting principally high-producing dairy cows. The plan of procedure, put into effect in January 1935, provides for physical examination of cows by qualified veterinary inspectors. The plan is voluntary on the part of cattle owners. Cows with marked cases of mastitis are eliminated, and the owner receives a Federal payment limited to a maximum of \$50 per head for purebred cattle and \$20 for grades. The owner receives the salvage and agrees to follow official directions for controlling the disease in his herd. He must also participate in the program for controlling Bang's disease.

During the first 6 months of the mastitis-control plan, approximately 3,800 owners submitted their herds to inspection. Of 94,919 cows examined, about 12 percent were found to be marked cases, 2 percent were classed as suspects, and the remainder were apparently free of mastitis. These figures are considered representative chiefly of dairy herds in which mastitis is known or suspected to



exist and whose owners are anxious to eliminate it. The extent of the disease throughout herds in general is thought to be very much less.

### Activities in Behalf of the Poultry Industry

Federal legislation, approved by the President August 14, 1935, requires that dealers in live poultry, in cities to be designated by the Secretary of Agriculture, must obtain Federal licenses and conduct their business under the type of Federal supervision already governing the marketing of other livestock. The new provision is an addition to the Federal Packers and Stockyards Act and is designed to prevent excessive charges and unfair and deceptive practices and devices at certain markets where live poultry is sold in large volume. Expected benefits include the reduction of excessive handling costs, thereby permitting better returns to producers and more reasonable retail prices to consumers.

In the commercial egg trade, certain markets discriminate against eggs having so-called "tremulous" air cells, this characteristic signifying that the cell, instead of being fixed in its normal place, has some movement and in extreme cases may even be free within the shell. The condition has been observed frequently in eggs shipped considerable distances, with the result that producers who depend on distant markets have been at a disadvantage. Experimental study of the condition has involved the shipment of eggs for distances up to 2,400 miles, with various types of packing, both loose and rigid. The data indicate quite conclusively that packs in which the eggs are held firmly result in fewer tremulous air cells than loose types of packing. Briefly, the condition can be eliminated to a large extent by the use of rigid-type packs.

### CHEMISTRY AND SOILS

In this period of extraordinary turmoil the research and service branches of the Department, equally with the economic and adjustment sections, have profound readjustments to make. The character, magnitude, and direction of these readjustments depend largely on agriculture's changing technical requirements.

Extensive crop shifts to meet altered market conditions involve correspondingly extensive modifications in farm practices, particularly in regions faced with the necessity of developing new sources of cash income. As production for export declines, areas that formerly specialized heavily therein must grow things that can be sold at home. They must regulate the amount, the kind, and the quality of their production differently. For example, the decline of our wheat exports creates new technical problems for the wheat areas. It obliges wheat growers to put more of their land into grass and forage and to go more into mixed farming. They cannot fully adapt old techniques to the new requirements. Crops, tillage methods, and farming systems useful elsewhere may not entirely suit the formerly specialized regions.

On the other hand, practices once efficacious in the regions not directly concerned in the export trade may become less efficacious as the agricultural pattern changes. Broad shifts from intensive to

extensive types of farming affect our agricultural economy as a whole and create new technical as well as new economic problems for farmers in all parts of the country. Should it be necessary for the South to raise more corn and hogs, the Corn Belt will have to raise less, and the resulting readjustments in the Corn Belt will have repercussions on the dairy regions and on the range States. Technical knowledge cannot entirely eliminate but it can lessen the resulting regional conflicts, provided it fits the new requirements with adequate local precision. In short, the farm crisis is technical as much as it is economic and makes calls as urgent upon the chemist, the animal husbandman, the plant scientist, the soil scientist, and the agricultural engineer as it does upon the economist.

### Findings of the Soil Survey

The Department has been fully conscious of these truths and has shaped its research accordingly. In the Bureau of Chemistry and Soils, for example, it has put increased emphasis on the investigation of soils as a basis not only for crop adjustments and crop shifts but for the conservation of soil and soil fertility and for guidance in land planning. Formerly, the Division of Soil Survey particularly studied methods of soil classification and worked out details for locating the boundaries of soil types on base maps. Knowledge thus gained enabled it to help immediately in dealing with the land-adjustment problems that became acute following the depression.

It has now mapped about half the nonmountainous portion of the United States and has covered much of the mapped areas by detailed surveys. On the greater portion it has completed surveys on a scale of 1 mile to the inch and has prepared maps showing in great detail the distribution of soil types and other physical features of the land. For nearly all regions it has sufficient information for general recommendations regarding land use and has completed a general soil map of the United States giving undoubtedly the best and most detailed presentation ever published of a country's land resources.

### Fertilizer Studies

Farm earnings are the result of three variables—volume, prices, and costs; and the relative importance of these factors changes from time to time. During the first years of the depression it was proper to emphasize volume and prices because surpluses and low prices were the outstanding facts in the agricultural situation. Nevertheless, costs did not cease to be important, and the Department continued to study ways and means of reducing them. The fertilizer problem provided a significant opportunity.

As farm returns decline, a dilemma arises for the farmer who desires on the one hand to cut down his expenses and on the other hand to increase his yield per acre. What he can afford for fertilizer depends partly on the prices obtainable for agricultural products and partly on the cost and utility of fertilizer materials. When costs threaten to exceed returns anyway, the incentive to use fertilizer drops almost to zero. Few farmers sufficiently appreciate the merely negative advantage of reducing their losses. With price recovery, the



incentive revives, but it will not be strong until the returns from applications of fertilizer demonstrably exceed the cost. In such circumstances efficient farming depends tremendously on the extent to which economies may be made in the purchase and use of fertilizers.

In recent years fertilizer developments largely initiated by the Department have reduced the cost and increased the usefulness of fertilizing materials. Formerly the raw materials for preparing commercial fertilizers came only from mineral deposits and waste products and had a low plant-food content. Mixtures from such materials were of low grade. There were no economical methods for preparing higher analysis mixtures. Research in the Department aided fertilizer manufacturers to obtain nitrogenous material of high plant-food content from the atmosphere at a lower cost than from any other source.

Other studies indicated how potash salts may be enriched at a cost substantially less than the savings in bags and freight and developed improved methods for preparing phosphatic materials of higher plant-food content. This Department developed the electric-furnace method, which the Tennessee Valley Authority is testing on a quantity-production scale. The final product has all the constituents of ordinary superphosphate, and more than twice as much plant food.

Full utilization of these improvements awaits a more general recognition of the fact that fillers, if put into mixed fertilizers to the customary extent, add unnecessarily to the retail cost. As yet, the new methods have not caused a marked increase in the average plant-food content of commercial mixed fertilizers, though they make possible the preparation of mixed fertilizers that have double the plant food of the average mixed fertilizer. The reason is that the use of fillers has increased almost proportionately with the use of the improved fertilizer constituents. Fillers constitute 20 percent of the average cotton fertilizer in certain Southern States.

That great savings would result from the elimination of filler and from the elimination of organic matter and of side dressing, when these changes would not affect the strength of the fertilizer, appeared from a study of the open price schedules prepared by fertilizer manufacturers under the National Recovery Administration Fertilizer Code. This study showed that a reduction of even 50 percent in the wholesale cost of the nitrogen, phosphoric acid, and potash materials in mixed fertilizers would reduce the retail cost only 9, 8, and 3 percent, respectively.

On the other hand, the analysis indicated that the elimination of filler, the elimination of organic matter with the discontinuance of the practice of side dressing, and the use of double-strength mixtures would effect a saving in the retail cost of 8, 15, and 22 percent. By using higher analysis fertilizers and by adopting approved changes in fertilizer practice, the farmer can use fertilizer profitably under circumstances that would otherwise forbid such action.

### New Uses for Crops and Byproducts

Farm adjustments necessitated by the loss of foreign trade emphasize the importance of developing new uses for crops and crop by-products. The Department has appointed a committee of scientists

from several of its bureaus to study the research now being done in this field and to indicate promising new lines.

At present the farmers have profitable uses for only about half of what they grow. The other half they must either throw away or turn to some relatively low-yielding use. For each pound of corn or wheat marketed the farmer discards about a pound of fodder or straw. Fruit and vegetable growers grade out a good percentage of their crops as culls and lose part of the crop as peelings and seeds. Chemists strive constantly to find ways of utilizing these wastes.

But the task is full of difficulties. Here again the technician and the economist must collaborate. Chemical research may develop methods that cannot be used in the prevailing economic situation or with existing manufacturing facilities. The successful economic use of new methods may require quantity production for an enlarged market and may necessitate economic research as well as commercial experimentation. Nevertheless, each year sees progress in the commercial application of the Department's research in the utilization of farm crops.

An example is the utilization of sweetpotatoes in manufacturing starch. Sweetpotato growers usually have to grade out a large percentage of their crop as culls; in fact, the culls may run as high as 30 percent. Though livestock consume part of the culls and though some find a market in the canning industry most of the culls have to be sold at a loss. The Department's chemists discovered how to make from sweetpotatoes a satisfactory starch to be used as sizing for stiffening and putting gloss on textile goods.

The most difficult problems in this task were getting rid of the yellow color in sweetpotatoes and developing an efficient manufacturing method. Scientists in the Department overcame the first difficulty and tackled the cost problem on a factory scale in a demonstration factory in Mississippi.

In the utilization of straw, hulls, corn stover, and so on, the problem is often to find uses more profitable than the present uses. These byproducts are worth something as feed in many parts of the country and are not always strictly waste materials. The problem is to determine whether corn stover, for example, will bring higher returns manufactured into fiberboard or into cattle feed. Some factories are making and selling large amounts of insulating board made from cornstalks, straw, and sugarcane bagasse. There is a wallboard made from cornstalks which can be used instead of plaster or as a subsiding or as a subflooring. One factory is already making this product. Its future depends on the relative cost, as compared with that of other materials, and that, in turn, depends largely on the quantity that can be sold.

It is well not to lose a sense of proportion in considering the industrial utilization of farm products and byproducts. Some enthusiasts, fired with extravagant hopes generated by a few successes thus far attained, believe that agriculture should aim primarily at supplying raw materials for the manufacture of industrial goods and should relegate its job of feeding and clothing the race to a secondary place. Such a change of emphasis, though not inconceivable, would necessitate prodigious technical progress, as well as an enormous increase in the spending power of the average consumer.



The direct need for food and clothing will constitute the main agricultural demand in any future that we can foresee, even if the population remains stationary or declines. Technical progress may enable agriculture to satisfy this demand with relatively less than the effort now required and to make some agricultural land and labor available for other objects. It is not likely to revolutionize completely the relationship between the farm production of food and clothing fibers and the farm production of other things.

We can give full recognition to the advantage of growing crops for industrial uses and of salvaging agricultural surpluses and wastes without assuming that the "tail has already begun to wag the dog."

## FOOD AND DRUG LAW ENFORCEMENT

In the field of food and drug law enforcement, regulatory activities have paralleled congressional consideration of the proposed new food, drug, and cosmetic legislation, described in some detail in the last annual report. Senate 5, a bill—

to prevent the adulteration, misbranding, and false advertising of food, drugs, devices, and cosmetics in interstate, foreign, and other commerce subject to the jurisdiction of the United States, for the purposes of safeguarding the public health, preventing deceit upon the purchasing public, and for other purposes—passed the Senate on May 28, 1935, and is now in the hands of a subcommittee of the Committee on Interstate and Foreign Commerce of the House of Representatives. This measure retains the meritorious features of the present Food and Drugs Act and provides added consumer protection in the way of control of cosmetics and curative devices, and of advertising. With the addition of a few essential amendments which the Department has recommended, the proposed new law will unquestionably constitute a far more effective agent for public protection than the present statute.

It has frequently been asked why a law like the Food and Drugs Act should be enforced in the Department of Agriculture. There are logical reasons for it. The food supply, and, to some extent, the drug supply, are largely products of agriculture. Nowhere outside the Department of Agriculture is there obtainable more comprehensive information about food production, composition, and manufacturing processes. No other department has so many bureaus whose related facilities can be utilized in effecting corrections of unsatisfactory conditions. This is illustrated nowhere better than in the vexing problem of spray-residue control wherein the Food and Drug Administration has exercised restrictive action under the terms of the law against shipments of fruits and vegetables containing toxic spray residues. The Bureau of Plant Industry has studied and developed procedures for removing excessive residues from fruits and vegetables; the Bureau of Chemistry and Soils has sought to develop effective substitutes for objectionable poisonous sprays, and the Bureau of Entomology and Plant Quarantine has cooperated in formulating rational spray schedules designed to give the maximum protection to the crops with a minimum of poisonous spray remaining at the time of harvest.

It is a foregone conclusion that a regulatory organization like the Food and Drug Administration which is called upon in its law-

enforcement operations to confiscate large quantities of adulterated food and drug products and prosecute the responsible shippers will be subjected to bitter condemnation by the individuals against whom the actions are directed. Sometimes, moreover, criticism comes from groups who claim to represent the consuming public and who assert that enforcement operations are inefficient and that the Food and Drug Administration is indifferent to the public welfare and shows undue solicitude for the producer and manufacturer of food.

### Seizures and Prosecutions

Trade complaints, however, originate almost exclusively among that small minority of producers or shippers who traffic in illegal foods and drugs. The majority are dealing exclusively in legitimate products and recognize that strict enforcement constitutes not only essential consumer protection but an important barrier against the unfair competition afforded by adulterated and misbranded products. As to the assertion that the Food and Drug Administration is indifferent to consumer welfare, the record speaks for itself. It shows that in the course of the fiscal year the Administration examined more than 60,000 foods and drugs. It initiated action in connection with more than 3,000 consignments, including over 2,000 seizure actions and over 1,000 prosecutions.

This record does not include over 200,000 specimens of cream from interstate and intrastate sources which were inspected in cooperation with State and municipal officials, with some 8,000 condemnations. It inspected more than 35,000 importations of foods and drugs, of which approximately 10 percent were excluded because of adulteration or misbranding. In connection with spray-residue activities alone, it examined over 6,000 samples of fruits and vegetables and instituted 338 seizures. In addition to its regulatory actions on this project it worked constructively with State authorities and growers' associations in an endeavor to assist them in so regulating packing and shipping operations within the various States as to guarantee effective cleansing, through voluntary action of the industry under State supervision.

### Research in Food and Drug Law Enforcement

In the early years of the Food and Drugs Act the enforcement staff had to cope with innumerable types of adulteration. Many of them were crude and easily detected by any chemist, though technical knowledge in this field was meager. Faced with prosecution, adulterators refined their methods; it became evident that the Government chemists would have to move fast to keep up with the lawbreakers. Soon the multiplicity of new products and the industrial application of science made it indispensable in the administration of the statute to carry on extensive research. It was necessary, moreover, that the research results should be as nearly as possible unchallengeable, as the findings were practically certain to be vigorously attacked in the courts.

Accordingly a research staff was organized to study the identity, composition, preparation, and storage of foods and drugs by objective



methods, so as to establish a basis for judging whether products offered for sale complied with the law. Though frequently intricate and difficult, the investigations are necessarily limited in type and scope. They seek to show whether products are injurious to human health, whether they contain filthy or decomposed material, and whether their character or their labeling cheats the consumer. The objective is consumer protection. Within this relatively narrow field, the nature of the work imposes certain conditions. It is important, for example, to have quick and simple methods for determining health risks, because the law requires that offending articles be intercepted in interstate commerce. Leisurely investigations will not do when dangerous products must be removed from trade channels.

Also the necessity of covering the entire United States makes it difficult to use costly or intricate apparatus in all cases. Finally, the investigational results must be such as to convince laymen, for judges as well as juries are laymen in this field. Moreover, the results must be convincing also to manufacturers who wish to comply with the law and to turn out goods free from harmful characteristics. Findings very significant to highly trained research workers may not look significant at all to the nontechnical mind. Yet in spite of these necessary limitations, research in the Food and Drug Administration puts effective barriers in the way of law violation and assists reputable manufacturers in fulfilling the law.

### Important Byproducts of Research

Sometimes the scientific work of the Food and Drug Administration yields important byproducts. Formerly, for example, many manufacturers of tomato products did not eliminate rotten tomatoes by sorting and trimming. Anyone can detect rot in whole tomatoes; but after the manufacturing process, which reduces the product to fine particles and strains and seasons it, the problem becomes infinitely more difficult. In the worst cases, changes in the characteristic acids in the tomato furnished evidence; but a real clean-up demanded more direct and reliable indications.

The problem was solved not by chemistry but by the microscope. Examining hundreds of samples of decaying raw tomatoes, and of catsup and of puree made from similar material, observers noticed that the rotten areas were really masses of microscopic mold filaments, and that the number of these mold filaments in the finished products correlated surprisingly with the percentage of rot in the original tomatoes. This method of detection appealed immediately to the manufacturers and distributors anxious to turn out and handle clean tomato products and simplified the task of the law-enforcement agency. It enabled the plant microscopist, by an examination requiring only a few minutes, to tell whether the sorters were doing their work properly. The mold-count method is now in practically universal use in plant control, and in the purchase of tomato products on specification. It is successful also in testing many other food products that tend to become unfit for use chiefly through the action of molds.

Recently the Food and Drug Administration developed improved methods for the determination of inorganic poisons in foods, and

the beneficial results promise to be extremely far-reaching. Some years ago, growers and shippers adopted a fruit-washing technique, devised in the Department and protected by a public-service patent, to reduce the lead arsenate spray residue on their products. Later a supposedly improved procedure was adopted by the industry. But the new method removed the arsenic more efficiently than it removed the lead, and a determination of the amount of arsenic that remained no longer indicated approximately how much lead was still on the fruit. Up to that time analysts had measured directly only the arsenic content, because a reasonably accurate lead determination required 3 days—much too long a period for control measures to be used by the fruit industry or by regulatory officials. Adoption of the new fruit-washing system necessitated the development of a new control method, and research in the Food and Drug Administration met the need. Scientists devised a method satisfactory in precision, requiring only half an hour, and having the great additional advantage of permitting the practically simultaneous examination of several samples. The Department made the new method available immediately to the fruit industry, and its scientists gave first-hand instructions to specialists in industrial laboratories. In the fall of 1934 lead determinations by this method, in industrial and regulatory laboratories, totaled at least 100,000.

This development is only one among many happy results of the new analytical method. The power of this method to safeguard the public health extends potentially far beyond its application to the fruit industry. Physicians and toxicologists manifested interest in it, from such widely varying viewpoints as the treatment of cancer, the study of industrial lead poisoning, and the determination of the lead content of the American dietary from sources other than spray residue. Research workers sought applications of the lead-analysis method to all food products and to biological materials. Toxicologists wished to use it in gaging more accurately the risk to health involved in consuming minute amounts of lead. In like manner, research in the Food and Drug Administration concerning fluorine, another insecticide, promises to have broad indirect results as well as results directly beneficial to producers and consumers of farm products.

### Study of Vitamins

Among the newer research projects of the Food and Drug Administration is a study of vitamins expressly to check the claims of commercial products. This is slow work. Chemical and physical tests furnish some help in the determination of vitamins in food products; but for various reasons the final determinations require the use of small experimental animals such as guinea pigs and rats. Under certain conditions, some of the vitamins are unstable, and nutrition studies with such animals help to disclose what precautions must be taken to preserve the vitamins. This problem touches both the health and the pocket of the consumer in obvious ways; dependence on unreliable sources of vitamins may emphasize the truth of the old saw that a little knowledge is a dangerous thing. Aroused public interest in the subject of vitamins may be exploited to the disadvantage of the public in the absence of trustworthy tests of the vitamin content of advertised products.



Recent discoveries about vitamin D, for example, have raised certain questions regarding the clinical value of certain commercial products. The Food and Drug Administration has cooperated with the Children's Bureau in the Department of Labor in efforts to establish the relative clinical value of vitamin D as it occurs in cod-liver oil and vitamin D as produced artificially by irradiation of ergosterol. The Food and Drug Administration determined the vitamin D potency of cod-liver oil, and of irradiated ergosterol and prepared them for use. The Children's Bureau made the clinical investigations. Earlier studies by other investigators had indicated that larger quantities of vitamin D in the form of irradiated ergosterol were necessary to produce the same effect as a given quantity of vitamin D from cod-liver oil. This finding the joint studies of the Food and Drug Administration and the Children's Bureau did not confirm. On the contrary, the investigations, which included observations on 377 infants, provided certain evidence that a unit of vitamin D from irradiated ergosterol prevents rickets as efficiently as a unit of vitamin D from cod-liver oil. Such findings are obviously of first importance in checking the claims made on the labels of commercial products, and also in providing physicians with dependable clinical information.

### Investigations in Bacteriology

Enforcement of the food and drug law also requires research in bacteriology. Food bacteriology furnishes data essential in determining whether or not foods are filthy, decomposed, or dangerous. Many types of filth in food can be detected without bacteriological examination; other types defy detection by other means. Filth consisting of waste materials from warm-blooded animals can often be detected only by bacteriological methods, and such filth, besides offending decency, is a serious menace to health. Progress in this field has closely followed that made in the study and control of communicable diseases. Methods developed in the Food and Drug Administration for the bacteriological examination of milk, water, shellfish, and more recently of canned foods, have thrown invaluable light on the significance of certain bacteria in food products.

It is particularly desirable to develop such methods, for determining bacteriological filth in foods commonly consumed in the condition in which they are produced, without further cooking. Fresh crab meat, picked by hand from the cooked crabs, packed in unsealed cans, and shipped in ice, is an outstanding example. This food is often produced under conditions which subject it to contamination. Investigations by the Food and Drug Administration some years ago, to ascertain the cause of food poisoning attributed to the consumption of crab meat, revealed grossly insanitary conditions surrounding the preparation of this product in many factories. Though the Food and Drugs Act prohibits the interstate shipment of filthy food, it does not provide for the control of sanitary conditions in food plants. It was imperative, therefore, to develop a method for determining the presence of filth in the finished product, in a way that could be translated into terms of improper handling.

Analysis to determine the presence in crab meat of bacteria of the colon group was the method finally adopted. Excessive num-

bers of these bacteria in drinking water and in oysters have been accepted for years as evidences of filth and as signs of danger. Cooked crabs ordinarily do not contain any such bacteria. Consequently, their presence in the picked meat indicates that it has been contaminated, and this is the present basis for determining the fitness of crab meat for consumption. The technique adapts to crab meat, procedures that have been well established in the analysis of other materials, and indicates with reasonable rapidity the prevalence of fecal strains of bacteria. Its use serves both as a measure of filth in crab meat and as an index of the sanitary conditions surrounding its preparation. The result has been a marked improvement in these conditions. State control agencies and technological advisers to the crab-meat industry use the method constantly. Further research may develop similar methods for application to other products which are excessively handled and exposed to contamination. The field is wide. It must be entered with caution, however, because only a thorough knowledge of the production, handling, and distribution of such products can show the significance that should be attached to the presence in them of colon bacteria.

## PLANT RESEARCH

The solution of problems related to crop production is a matter of years. The improvement of plants by breeding must extend through many generations. Varieties must be compared in a number of different kinds of seasons for correct evaluation. The same is true of tests of fertilizers, spraying practices, and cultural methods. To be productive, a program of plant research accordingly must be stable, with a concentration of effort until a given problem is solved or its solution found impracticable for the time being. Following such a program, the Department's plant scientists have continued to contribute to the efficiency of the plant industries and thereby to social and economic progress.

Perhaps nowhere is the importance of continued research better exemplified than in connection with diseases of forest trees. With the enormously expanded program of tree planting and conservation activities, the Department's pathologists have been under constant pressure for aid. In many cases the needed information was available through earlier research; in other cases, available information provided a background for rapid solution of new problems. Thus, investigations of the damping-off of pine seedlings in forest nurseries were begun in 1907 and have been continued since, as opportunity offered. Results available permitted decided immediate reductions in losses of seedlings in the extensive nurseries and also established a basis for rapidly developing simplified methods of control. Without this background of research far heavier losses would have occurred, and the whole program would have been seriously retarded.

### Plant Breeding

The development of rust-resistant wheat varieties exemplifies well the importance of continuous research. The Ceres variety of wheat had an enviable record of yield, quality of product, and resistance to stem rust. True, it was known to be susceptible to some of the



forms of rust, but these had not been important in the Dakotas and Minnesota on some 5,000,000 acres on which Ceres was grown. During 1934, however, spores carried by the winds from Texas and Oklahoma introduced forms of smut to which Ceres was not highly resistant, and yields of this variety were low. At the same time, the Thatcher variety of wheat, developed in cooperation with the Minnesota Agricultural Experiment Station, withstood the rust and produced satisfactory yields. The resistance of Thatcher is derived from durum wheat, and its combination with the good qualities of the common wheats in Thatcher represents a distinct forward advance. Hope wheat, developed from a hybrid with emmer, is even more highly immune than Thatcher. It is inferior in yield and quality, however, and its value lies in its use in further breeding efforts.

### Grass Investigations

Since the beginning of farming in this country success or failure has to a large extent centered on knowledge of forage grasses and how to use them to the best advantage. Taking the grasses as a whole, there is no other group of plants so important and so vital to mankind. Besides the forage grasses used for meadows, pastures, soiling crops, range purposes, both open and in our great forest reserves, there are the food grasses, including all our great cereal-grain crops, industrial grasses such as sugarcane, and the vastly important group known as bamboos. The bamboos alone furnish food, shelter, clothing, household furnishings, and a multitude of domestic supplies for nearly a quarter of a billion people, mostly inhabiting the warmer parts of the Orient.

We are here concerned with forage grasses, forming the group indicated above and it is evident that we are moving, and moving rapidly, toward new frontiers of farming, where such grasses must play even more important roles in the fundamentals of agricultural practice than they have in the past. The forage grasses possess the needed attributes to act as "shock absorbers" in future efforts at balancing production, conserving our heritage, or what is left of it, of soil fertility, widening of opportunities for crop diversification, and opening new fields for plant and other industries.

Ever since the Bureau of Plant Industry was organized 35 years ago, it has done systematic work in taxonomic research, involving critical studies of all known native and introduced species and varieties of grasses in the United States. These studies have had to do largely with determining the botanical relationships of the different species and varieties and recording clearly defined scientific descriptions and geographic distribution, along with comments on habits, uses, and history of each species and variety. The results of this work have been set forth from time to time in various departmental publications, and within the past few months have culminated in the publication of an exhaustive and monumental Manual of Grasses of the United States, in which are described 159 genera, 1,100 species, and 151 varieties now known to occur within our borders. Text figures to the number of 1,700 accompany the descriptions, the whole constituting a valuable, highly important, and necessary background or basis for future work in any of the new and specialized fields

involving the utilization of members of this important group of plants. Soil-erosion experts, soil conservationists, specialists in farm management, plant breeders, and plant introducers will, it is believed, find this reference book highly useful and helpful in their respective fields.

### Species and Varieties from Abroad

In the grass investigations so far conducted by the Department, those concerning the introduction of species and varieties from foreign countries have played an important part. It is interesting to note in this connection that practically all of our widely used grasses, constituting our chief reliance for meadows, pastures, lawns, golf courses, soil binding, and soil protection are immigrants introduced either accidentally or intentionally from foreign countries. The reasons for the success of introduced grasses as against our native species are not fully understood. The fact that this is the case would seem to point to further advantages that may accrue from careful and systematic efforts in searching the world for additional species, varieties, and forms. For 30 years or more plant scientists in the Department have made many explorations in foreign lands in search of new crop plants, including grasses. Several hundred species and varieties have been introduced, duly described in our official plant inventories, grown, tested, and distributed. Many species and varieties have also been acquired by correspondence through studies of botanical and agronomic literature of foreign countries.

A striking instance of the value of botanical knowledge of world flora is found in the introduction of Sudan grass. A grass was desired with the good qualities of Johnson grass but without the creeping rhizomes which have made this last grass a real pest. One of the botanists of the Bureau of Plant Industry predicted that such a grass would be found in the Anglo-Egyptian Sudan, and in 1909 Sudan grass, answering in every respect the special needs required, was introduced by the Department of Agriculture. Sudan grass is an annual belonging to the sorghum family. This grass makes a nutritious and palatable hay, greatly relished by both cattle and horses. The grass, since its introduction, has attained wide popularity as a summer pasture crop and has exceptional merit for supplemental pasture during the customary drought period of late July and August. The area planted with this grass is about 1,000,000 acres each year.

Among other grasses introduced by the Department which are now filling more or less important needs are crested wheatgrass, introduced from Siberia in 1898; centipede grass, from China in 1918; Napier grass from equatorial Africa in 1913; Rhodes grass, a drought-resistant species brought from South Africa in 1902; Natal grass, brought from South Africa in 1891; and woolly fingergrass, introduced from South Africa in 1928.

The introduction of these grasses and the studies made of them have served greatly to advance and maintain a successful agriculture in sections of the country where it had been difficult to grow grass crops. All such introductions necessarily require careful testing for value. These scientific tests and studies are conducted at



Department field stations and in cooperation with State experiment stations in all parts of the United States. Often very small quantities of seed are obtained, and to avoid losing all in field plantings, through risks of climatic conditions, some of the seed is germinated in the greenhouse and the seedlings well-rooted in pots before they are sent to the field. This method has proved successful. Along with this work, grass nurseries for testing introductions have been maintained at strategic points in the Middle West, the South, and the Southwest, and on the Pacific coast. The determination of the territorial limits of adaptation, as well as the cultural requirements and feed value, of these introduced grasses has been a matter of first importance and will require continued attention in the future, since new grasses are introduced each year.

### The Problem of Breeding Grasses

In the field of breeding grasses, lack of knowledge of proper technique and inherent difficulties in handling the floral parts has limited the endeavor. One other reason may also be set forth—namely, the fact that so many new and promising grasses have been coming forward through introductions that the need for breeding work has not been felt so strongly with this group of crop plants as with some others. However, the time is at hand when it would seem that breeding work might greatly advance our field of knowledge of this important group. Such work has been inaugurated on a scale commensurate with its importance.

## AGRICULTURAL ENGINEERING

Recent changes in economic conditions have shifted the emphasis of research in the utilization of irrigation water from attempts to obtain the maximum crop from a limited supply of water to efforts to lower the cost of crop production. Investigations in the Bureau of Agricultural Engineering indicated that labor costs and investment in distribution works usually can be reduced with increased efficiency in the application of the water.

The situation in the Northwest boxed-pear industry is illustrative. A few years ago there was a market at high prices for all pears produced in the Medford, Oreg., area. Even poor orchards on poor land were profitable. Normal production now exceeds the demand, and marketing agreements are in effect to withhold the less desirable sizes from the market. However, a large part of the crop is exported, and any great artificial price increase will cut off much of the foreign market. Research suggests that irrigation of the better orchards may be pushed beyond maximum yield per unit of water, well toward maximum yield per unit of land area. By concentrating water on the better land and forcing poorer land out of production, production costs may be reduced.

Because tractor fuel must be purchased whereas stock feed can be produced on farms, some reversion from mechanical power to animal power for farm work took place when farm incomes declined after 1929. The change appears, however, to have been only temporary, despite acreage limitations under the crop-adjustment pro-

grams. In areas hard hit by the drought last year, dependence on home-grown feed is a disadvantage. Rental and benefit payments to farmers have provided some funds for the purchase of power equipment, and manufacturers of farm tractors are operating at capacity. Small general-purpose tractors are especially in demand.

The small general-purpose tractor, fairly suited in size and cost to the needs of a farm of moderate size, is one of the most important improvements made in farm machinery in the last few years. It was available in quantities in 1933 and met with ready acceptance. Previously the movement in farm-machinery design had been toward more powerful tractors and larger capacity tillage and harvesting equipment, the use of which involved a considerable investment.

### Rubber Tires On Farm Machinery

Another development has been the use of rubber tires on agricultural machinery. These permit greater speeds between field and farmstead and between field and field. Rubber-tired tractors, for road speeds of 30 miles per hour or more, may soon be available. Farmers will be able to use them with inexpensive trailers, and will have less use for motor trucks. By absorbing shock and vibration, rubber tires prolong the life of the equipment on which they are used and under some soil conditions give better traction in field work than wheels with steel lugs.

The small combined harvester-thresher may replace many binders and threshers in the Corn Belt and the Middle and South Atlantic States. Apparently this machine harvests and threshes satisfactorily a greater variety of crops at less cost both for purchase and for operation than the machines it is replacing.

Three years of experimentation in Alabama with machinery used in growing cotton indicate a radical and profitable departure from customary tillage practices in some sections. Many of the more elaborate methods of seedbed preparation have been followed consistently by lower yields of seed cotton. Apparently these methods destroy desirable soil-structure conditions. This indication emphasizes the importance of the work planned for the Department's new farm-tillage machinery laboratory at Auburn, Ala., which has just been completed with Public Works Administration funds.

American lint cotton in world markets has been severely penalized on the basis of low spinning quality, presumably due to rough ginning. Under the authorization for cotton-ginning investigations enacted in 1930, laboratory experiments with commercial equipment have demonstrated the advantage of artificially drying sappy or damp seed cotton before ginning in bettering the grade of the lint and reducing the chokages and delays in ginning operations usually experienced with moist cotton. Drying increased the lint value of wet long-staple cotton about 8 percent, and that of wet short-staple cotton about 2 percent, on the basis of central market prices. Both the "Government" cotton-drying process and the vertical seed-cotton drier are inventions for which public patents have been granted to a Bureau engineer. This type of drier is rapidly becoming standard cotton-gin equipment, especially in the Mississippi Delta region. Fast ginning, characterized by a tight seed roll, has been found to have a tendency to lower the preparation and grade of the lint, which has been especially



evident with the longer staple cottons. A promising means of obtaining the advantages of the loose seed roll without sacrificing speed of ginning seems in view. Continuation of the cotton-ginning investigations is confidently expected to obtain improvement of ginning practices that, when generally adopted by ginneries, will result in great improvement in the quality of the American cotton crop.

### Machines for Sugar-Beet Work

The importation of transient labor into some areas for sugar-beet work involves social as well as economic problems. A mechanical means of cross-blocking has been devised by the Department's engineers which reduces the labor required and also reduces the cost for blocking and thinning the beets by more than one-third. A harvester developed in cooperation with machinery manufacturers reduces the labor requirement at the end of the growing season. With the needs of the crop more nearly within the resources of the producing areas and with growers less dependent on hired labor, the undesirable features of transient labor will largely disappear.

A farm-housing survey in 1934 focused attention on the run-down condition of many farmhouses and the general lack in rural districts of such conveniences as clothes closets, running water, plumbing, central heating systems, and electric labor-saving equipment. While the present need for repairs and the general deteriorated condition of farmhouses is, no doubt, due largely to the depression, the lack of conveniences cannot similarly be blamed on the hard years since 1920, for the same lack existed also during the relatively prosperous period from 1910 to 1920. In proof of this, the 1920 Census shows that only 10 percent of the farmhouses had water piped to them; therefore 90 percent had no plumbing. It is certain also that less than 10 percent of the farmhouses had adequate heating equipment or electric conveniences in 1920.

The long-standing low level of housing on farms is probably due in large part to the public attitude toward the farm home. The prevailing view has been that earnings and savings should be invested in land or other productive equipment, to enlarge the farm business. This neglect of the home and emphasis on production may have contributed to the piling up of surpluses and the collapse of farm prices. It doubtless has been partly responsible for the migration from country to city of many retired farmers and many young people desirous of a better living.

### ECONOMIC RESEARCH AND SERVICE

The Bureau of Agricultural Economics was organized in 1922, when the first great post-war crash in the prices of farm products had focused public attention upon farm economics. It became a sort of central economic clearing house for agriculture and undertook comprehensive studies of the production, marketing, and distribution of farm products.

The Bureau's activities covered research, market news, and inspection, and the administration of certain laws such as the Grain Futures and Cotton Standards Acts. From 1920 onward, farmers had

to face distorted price relationships. The Bureau of Agricultural Economics accordingly developed methods of price analysis to show the trend of prices and of price relationships. It established price indexes currently and for pre-war years, to serve as a stable basis by which to compare later movements. These indexes became a basic measuring stick for farm-relief legislation. The parity-price objectives set up in the Agricultural Adjustment Act originated directly in the indexes which were established as a result of the Bureau's research in price analysis.

The Bureau also made numerous analytical studies of the prices of individual farm products, and these studies became useful as guides in production and marketing. Many interesting facts were established quantitatively for the first time. For example, a study of lamb prices considered the relation between the supplies of dressed lamb, the price of lamb at wholesale, the price of competing products such as beef and pork, the price level or the value of money, changes in the purchasing power of consumers as indicated by business activity, and the differences in demand throughout the season. From these data it became possible to forecast the price of lambs within a margin of accuracy that about equals the forecast of supply. Comprehensive facts were established on the movements of prices of the other principal farm products, such as hogs, beef cattle, potatoes, wheat, corn, cotton, apples, etc. Similar work was carried forward in the analysis and forecasting of the acreage, the yield, and the production of most of the important products.

Estimates of the size of the crops had been made for many years. Farmers had need, however, of advance information to guide planting and breeding. The Bureau developed a new type of crop report, which summarized the farmers' intentions to plant given crops. For several years now these intentions-to-plant reports have been issued well in advance of planting dates in most States, and have given farmers an opportunity to change their plans when there is danger of shifting too far in one direction.

The intentions reports on potatoes, plantings of which do not depend on weather conditions, have so modified farmers' plans that it has been necessary to extend the service on a regional basis. As the planting season progresses from south to north, potato growers in each belt of States get statistics on the acreage already planted to the south and on the acreage planned by growers in their own group of States. Potato growers are now able to avoid some of the heavy losses they formerly suffered through ignorance of prospective plantings.

The frequency, accuracy, and variety of the crop reports helped to make possible the successful development of the Agricultural Adjustment Administration production-control programs. In turn, these programs necessitated still more varied and frequent crop reports. The crop-estimating service last year issued a warning late in May that a national shortage of hay was unavoidable and that some of the principal grain crops were seriously threatened by drought. This warning caused the Agricultural Adjustment Administration to modify the crop-control programs while there was still time for an extensive planting of soybeans and other late crops. As a result, the shortage of feed and fodder in the fall of 1934 was less serious than it would otherwise have been.



## Research in Marketing

The gross income of farmers can be increased in either of two ways: (1) By inducing consumers to spend more for agricultural products, and (2) by reducing charges for transportation, processing, and marketing. During the past 2 years the emphasis of the Agricultural Adjustment program has naturally been on the first of these. Unsalable surpluses have been reduced or eliminated in order to raise prices and to induce domestic consumers to spend more money for agricultural products. The incomes of farmers have been raised substantially by this process.

However, it is apparent that consumer expenditures for agricultural products cannot be raised indefinitely by any action of farmers, since it is definitely limited by the amount of income the consumer has to spend. Until consumer incomes rise from their present levels consumers are not likely to spend much more for food and other agricultural products than they did this year. Our production program, therefore, should not call for continued reductions, but only for a prevention of recurring surpluses.

There is still an important possibility of increasing the income of farmers and at the same time greatly benefiting consumers by more efficient transportation, processing, and marketing. A new Division of Marketing Research has been organized this year in the Bureau of Agricultural Economics, and one of its principal purposes will be to discover more efficient methods which will lower the high spread between prices received by farmers and prices paid by city consumers.

Among the first studies undertaken in the new Division are several statistical comparisons of prices at the farm with prices in city retail stores in order to get a good estimate of price spreads. Estimates have been published covering 10 important foods: Beef, pork, hens, eggs, milk, butter, cheese, potatoes, flour, and bread. A month's supply of these foods cost a typical workingman's family \$19.06 in 1934. The farmer received \$7.34 cents for the farm products used in making these foods, while the remaining \$11.72 went to pay the various charges between the farmer and the consumer.

Of each dollar spent by the consumer for these 10 foods, the farmer got 38½ cents. Probably if all goods were included in the estimate, the farmer's share of the consumer's dollar would be somewhat less than 38½ cents, as no fruits or vegetables are included in this list of foods, and the farmer's share of the dollar spent by consumers for some fresh and canned fruits and vegetables is very low.

During the decade from 1920 to 1929 the farmer received about 50 cents of each dollar spent by consumers for these 10 foods. His share dropped after 1929 because charges for transportation, processing, and marketing were not reduced (and probably could not have been reduced) in proportion to the drop in food prices. The tendency for marketing charges to be relatively inflexible has been a very important factor in reducing the incomes of farmers.

## Prospects of Getting Results

It is not a simple matter to reduce marketing costs, but if we realize the importance of these costs and undertake an adequate program of marketing research we should be able to make some

progress. Fraudulent practices and dishonest charges can be greatly reduced by good enforcement of proper legislation. Unnecessary duplication of services and facilities, both in the country and in the city, can be avoided, at least in part, by education, by cooperative marketing, and by marketing agreements. Transportation rates both by rail and by truck need continuous study to provide farmers good service at the lowest possible rates. Facilities in many of our largest terminal markets are very inefficient and add greatly to marketing costs, cause unnecessary spoilage, and reduce the potential consumption of foods.

Farmers and middlemen are constantly experimenting with new marketing methods, and these experiments must be watched carefully in order that real improvements may be adopted as quickly and as generally as possible. Among the most important recent developments are the increased amount of direct marketing of almost all farm products, the rapid growth of distribution by motor truck, the development of auction markets at country points, new methods of cooperative marketing, and the growth of large chain-store systems and other large distributors of farm products.

Most of these developments have good and bad features. Some of them doubtless offer possibilities for more efficient marketing. All of them, and many other marketing developments, should be carefully studied with a view to developing in this country the most efficient marketing system possible.

## HOME ECONOMICS

For the general welfare, it is important that the products of the Nation's business, whether in agriculture, industry, science, or the arts, be fitted to the needs of the consumers. Ill-planned or unplanned production, disregarding or unaware of consumers' actual needs, makes for waste and maldistribution of supplies. But it is no less important that consumers make intelligent, economical choice and effective use of the products spread before them by the vast producing machinery of our times. Ignorant, haphazard, uncritical choice, and wasteful or harmful use of goods and essential services work to the detriment of consumer and producer alike, and thus of the Nation as a whole.

The ultimate consumers, however, live in family groups, and it is for the household unit that a vast proportion of producers' goods are purchased. The producer and the dealer are dependent not only upon the purchasing power of the family, but upon the ways of life in the household, its needs, desires, and standards. And considered in the large, the character, quantity, and uses of the goods the household buys are vital not only to the health and well-being of the family, but to the living standards of community and Nation.

The management of the Nation's households thus affects the whole national economy. Changes in household standards or technique create new demands upon industry, new markets for its goods. The producer and the technician have their stake in the economics of household management, just as the housekeeper has her stake in the economics of agriculture and industry whose goods and services she buys.



The Department of Agriculture, realizing the interdependence of farm producers and home consumers, studies consumption problems from both points of view. One of its agencies for this purpose is the Bureau of Home Economics. The broad economic purpose of the Bureau's program is to raise national levels of living by encouraging more effective consumption. At the same time, by study of consumers' needs, it points the way to more effective production.

Carried out in detail, such a program must deal with all the everyday problems of the home and family. Practical home economics means economical management of the family income and intelligent buying of the commodities of household use. It means knowing foods and markets, food values and diet, quality in clothing materials, household goods, and fittings. The care of the house, the preparation of the food, and the housekeeping job as a whole require a hundred skills. Home economics is in fact the science of applying science to the household.

### The Scientific Approach

As a science it must be studied. Even the "born housekeeper" cannot know by instinct all she must know to run her home efficiently. For the elemental task of feeding the family there is a world of new knowledge nowadays. Physiologists, nutritionists, and clinicians are showing the close relation between the kind of food we eat and our health. The Bureau of Home Economics studies food, food values, and nutrition, and applies the findings to the practical everyday task of meal planning with reference both to good diet and to costs. So also with clothing, house furnishings, and housing, the Bureau studies fabrics, methods of use, construction, and care, to determine the qualities in ultimate-consumer goods contributing the most to consumer satisfaction, and to establish standards to guide the consumer in buying. Finally, the Bureau's studies seek to show how goods and services available can be combined best to meet the needs of families of varying composition and different levels of income.

In the field of food uses, considerable advance has been made. Some of the Bureau's studies have been directed to show by diet patterns how families of various sizes may select their food to meet, at different cost levels, current food habits and at the same time the demands of good nutrition. These same diet plans tie in fundamentally with the land-utilization and food-production plans of the Department of Agriculture. The Department, while mainly concerned with production which will be most profitable to farmers, has also a responsibility for the protection of national health, and food production should be planned with the requirements of national health in mind.

Such food plans are necessarily drawn in broad, general lines. The detail must be filled in with many special studies, which, of course, take on a new significance when viewed as a part of the whole. The importance of small things in nutrition—the vitamins and trace mineral elements—makes much detailed research necessary and ties the human-nutrition studies in rather closely with the scientific studies of the various production bureaus.

Composition of food varies with the soil and other cultural conditions. Certain soils produce foods toxic to animals and also to humans. In other areas the soil conditions are such that foods grown there are deficient in some mineral element, as for example, copper and iron essential for hemoglobin formation, with the result that a high percentage of anaemia is found in the children fed too exclusively on foods grown in these areas. Although problems such as these would probably yield to fertilizer treatment, food-composition studies help to show where such treatment is necessary, and by cooperative effort the condition can be corrected with considerable advantage to public health.

### Clothing and Housing

While the relation of clothing to health is not so direct as that of food, the expenditures for clothing and household textiles come next to costs of food in many families, and the selection and care of these commodities are an important economic consideration in the family budget. The Bureau studies the composition of textile fabrics with a view to guiding the consumer in the choice and use which will contribute most in real satisfaction. Wise choice and care of clothing may add much to self-respect and happiness as well as to the physical comfort of the individual.

### DAIRY INVESTIGATIONS

Improvement in the great mass of our milk-cow population will depend on the development of breeding herds from which the average dairyman can obtain herd sires that will consistently beget uniformly high-producing daughters. The Bureau of Dairy Industry is demonstrating the possibility of developing herds or strains of dairy cattle of such purity in their inheritance for high production that practically all the females born in the herd will be high producers and the young bulls can be counted on to transmit high levels of production. For example, 49 young Holstein-Friesian bulls bred in the experimental herd at Huntley, Mont., have sired a total of 579 daughters in farmers' herds near that station. These daughters averaged 11,227 pounds of milk and 404 pounds of butterfat, an average increase of 1,452 pounds of milk and 57 pounds of butterfat over the production of their dams. Many of the records were made on farms where little or no grain was fed. Only 5 of the 49 young bulls lowered average milk production, and only 3 lowered average butterfat production, and in each case by insignificant amounts.

During the year the Bureau began a study to determine in commercial breeding herds and in college and experiment station herds, what progress has been made toward fixing an inheritance for high levels of milk and butterfat production. When all these herds have been analyzed, dairy-cattle breeders will be in position to make more rapid progress in developing "pure-line production" herds by concentrating and extending the use of the superior germ plasm of outstanding strains and herds.

Roughage crops usually produce the nutrients necessary in dairy production at less cost than the grain crops. With grasses and



perennial legumes the cost is often less than half as much as with the grain crops. Feeding experiments at various field stations show that good dairy cows will produce remarkably high yields of milk and butterfat when fed exclusively on good-quality hay and other roughage. On an average, these experimental cows have produced from 65 to 75 percent as much butterfat when fed exclusively on good roughage as when fed the so-called "full grain" ration and roughage; when fed roughage and a half grain ration they have produced 90 percent as much as when fed a full grain ration. Since approximately three-fourths of a cow's potential production can be obtained with roughage nutrients that cost less than half as much as the grain nutrients, the wisdom of devoting the greatest possible acreage of the farm to grass and roughage crops is apparent.

### Use of Dairy Byproducts

One of the most promising possibilities for increased returns lies in the development of a wider use of the byproducts of dairy processing plants. Nearly half the milk produced in the United States is used in the manufacture of butter and cheese and other dairy products. In the manufacture of butter, only the fat of the milk is used; in the manufacture of cheese only the fat and casein and a relatively small proportion of the soluble constituents are used. The remaining milk solids are left in the skim milk, buttermilk, and whey. Thus in producing the butterfat for the 1,650,000,000 pounds of creamery butter made last year, farmers produced something like 3,000,000 pounds of other milk solids that were not used in the butter. The whey from cheese manufacture contained an additional 300,000,000 pounds of milk solids not used in the cheese. Although nearly as much feed is required to produce the solids not fat as is required to produce the fat on which the farm value of the milk is based, the market price per pound for the solids not fat is only about one-fourth that of the fat. Furthermore, only a part of the potential output of solids not fat is marketed, even at this relatively low price. Rather than encourage higher butter and cheese prices, whereby consumption may be curtailed, substitutes used, and imports encouraged, the Department considers it much more desirable to obtain a fuller recognition of the value of the milk solids in byproducts, particularly their value as human food.

### GRAIN FUTURES ADMINISTRATION

Two cases of outstanding importance, involving charges of price manipulation and making false reports to the Grain Futures Administration, were brought during the year before the Commission named in the Grain Futures Act. The Commission is composed of the Attorney General, the Secretary of Commerce, and the Secretary of Agriculture. In both cases the respondents were prominent exchange members.

One of the respondents caused at least eight commission houses in Chicago to keep false records and make false reports to the Government. He traded through 35 different accounts carried in the names of relatives and friends. Had the Commission in its proceedings joined as parties the commission houses involved, the resulting liqui-

dation of open trades would have affected the market greatly and injured countless innocent persons.

Short sales of wheat by this one operator over a 2-year period amounted to more than 73,000,000 bushels. At one time he was short 7,525,000 bushels. In 1930 he was short 79 percent of the time; and in 1931 he was short 89 percent of the time. Yet in 1932 he caused a series of articles to be published picturing himself as being always a speculative buyer, and complaining that the Grain Futures Act hampered his speculative activities.

In the other case, the Commission found the respondent guilty of having in 1931 cornered the July corn future at Chicago. The price was forced up 14 cents per bushel during the last 3 days of the delivery month. Only in isolated instances could producers take advantage of the temporary boost in prices. Other markets and other futures were not affected. In this case, too, the respondent used dummy accounts.

In each case the Commission found that the respondent had violated the Grain Futures Act, and issued an order denying him trading privileges on all contract markets for 2 years. Both cases have been appealed to the United States Circuit Court of Appeals in Chicago, and meanwhile the orders are in abeyance.

The principal point of the defense in both cases was a deficiency alleged to be in the Grain Futures Act, which says that if the Secretary of Agriculture has reason to believe "that any person is violating any of the provisions of this act, or is attempting to manipulate the market price of any grain" he may initiate proceedings. It was contended that the use of the word "is" limits action to cases in which a person is caught in the act of violating the law or of attempting to manipulate prices, and that no proceeding is authorized against a person who has completed the act of violation or manipulation.

To obviate this contention in the future the words "or has violated" are added to the language above quoted by the bill to amend the Grain Futures Act, H. R. 6772, of the last Congress, which passed the House of Representatives and was reported favorably by the Senate Committee on Agriculture and Forestry. It would also bring price manipulations and market cornering within the penal provisions of the act, and subject offenders to fine and imprisonment. The prospect of a jail sentence would discourage from attempting either to manipulate prices or engineer corners many who otherwise might risk suspension from trading privileges.

### Proposed Amendments to the Law

Proposed amendments to the Grain Futures Act would authorize definite limitations on short selling and on purely speculative trading. They would make it unlawful for commission firms to cheat, defraud, or deceive customers, or to use the margin moneys of their customers for the benefit of others. They would outlaw cross trades, wash sales, and other devices for registering fictitious trades or fictitious prices.

Also, the amendments would guarantee that cooperative associations admitted to membership in the grain exchanges would have the benefit of a hearing before the Commission named in the Grain Futures Act before being suspended or expelled. Under present law.



if cooperative associations are suspended or expelled without cause, they may appeal to the Commission; but the only remedy which the Commission can give is to revoke the contract-market designation of an exchange and stop future trading on it entirely. Meantime, during the litigation, which may take a year or more, the cooperative association is without membership privileges.

It seems desirable to preserve future trading, because a properly conducted futures market affords facilities for hedging by dealers against price changes. Continued opposition by the exchanges to more appropriate and more adequate control measures must lead ultimately, however, to the adoption of other methods of insuring against market risks. Unless the system can be conducted on the high plane of responsibility required of other institutions that similarly affect the public interest, the Government will be called upon to supply some form of price insurance that will merit public respect and public confidence.

### ROAD CONSTRUCTION

Road construction in which the Department participated during the year resulted in the completion of improvements on 21,722 miles of roads and streets. Of this large mileage, 19,033 was improved with funds administered for the Federal Government solely by the Department. The remainder consisted of 99 miles of national-park roads, built for the National Park Service by the Bureau of Public Roads; 2,501 miles in loan-and-grant projects of the Public Works Administration, also supervised by the Bureau of Public Roads; and 89 miles in work-relief projects on which labor was supplied by the Federal Emergency Relief Administration, other costs were paid with Public Works funds, and supervision was furnished by the Bureau of Public Roads and several State highway departments.

By far, the larger part of the work on which the Department was the sole Federal agency consisted of construction carried out under various appropriations in cooperation with the highway departments of the various States, Hawaii, and the District of Columbia. Projects of this class completed during the year involved 17,344 miles of roads and streets—11,092 miles on the Federal-aid highway system outside of cities, 1,205 miles on extensions of the Federal-aid system into and through cities, and 5,047 miles classed as secondary or feeder roads. Also completed were improvements on 1,232 miles of forest highways and 456 miles of highways through other public lands built by the Bureau of Public Roads, and 8,962 miles of forest roads and 3,242 miles of trails built by the Forest Service.

At the close of the year the current program involved improvement of an additional 30,238 miles in all classes of projects, including 8,414 miles on the Federal-aid system outside of cities, 1,226 miles on city extensions of the Federal-aid system, 8,395 miles of secondary or feeder roads, 1,225 miles of forest highways, 45,047 miles of lesser forest roads and 103,048 miles of trails, 481 miles of public-lands highways, 725 miles of national-park highways, 1,134 miles in loan-and-grant projects, and 8,638 miles of work-relief roads, the last three supervised by the Bureau of Public Roads as agent for other Federal departments.

The Federal funds available for road construction and used in the work of the year were provided by a number of appropriations. The total expenditure from funds placed directly at the disposal of the Department was \$290,300,699. Of this sum, the largest amount, \$215,083,475, was drawn from the \$400,000,000 earmarked for highways in the National Industrial Recovery Act; \$44,791,372 was from the \$200,000,000 fund authorized by the Hayden-Cartwright Act of June 18, 1934, and lesser amounts were derived from other appropriations, as follows:

Emergency Relief and Construction Act of 1932-----	\$2, 135, 663
Federal-aid highway appropriations-----	12, 657, 267
Appropriations for forest highways, roads, and trails-----	11, 753, 962
Appropriations for roads through public lands-----	3, 878, 960

These expenditures do not include \$34,800,000 disbursed to State highway departments in advance payment for work authorized by the National Industrial Recovery Act and the Hayden-Cartwright Act, or expenditures by States for work completed on projects, probably exceeding \$80,000,000, for which reimbursement had not been made by the Federal Government on June 30. Nor do the reported expenditures include any sums paid for work done on national-park highways under the engineering supervision of the Bureau of Public Roads, for loan-and-grant highway projects approved by the Public Works Administration, or for work-relief projects also supervised by the Bureau.

At the close of the year there was an unobligated balance of \$36,717,772 in all highway funds appropriated directly to the Department, including \$5,018,643 appropriated by the National Industrial Recovery Act, \$28,241,383 authorized by the Hayden-Cartwright Act, and other funds for forest- and public-lands road construction amounting to \$3,457,746.

To these balances there were added on July 1 additional funds authorized for the fiscal year 1936 in the amount of \$137,500,000, consisting of \$125,000,000 for Federal-aid highways, \$10,000,000 for forest highways, roads, and trails, and \$2,500,000 for roads in public lands. When to these are also added the \$400,000,000 recently allotted for highway construction and the elimination of hazards at railroad grade crossings, the total funds available at the beginning of the fiscal year 1936 is raised to \$574,217,772. Of this amount, all but the balance of \$36,717,772, above mentioned, has become available since June 1, 1935.

### Provision of Employment

In the highway work of the past 2 years the provision of employment has been the predominant motive, and various conditions have been imposed to increase the amount of individual employment furnished by the expenditure of the Federal funds. Among these have been the general limitation of hours of labor to 30 a week, the substitution of manual labor for machine work wherever practicable and consistent with sound economy and public advantage, the requirement that projects be developed in relation to employment need and in as many places as practicable, and the stipulation that the labor directly employed on the road work be obtained from local agencies of the United States Employment Service.



The effect of this effort is shown in the record of employment furnished, which slightly exceeded in 1935 the previous high record of the fiscal year 1934. The total employment furnished during the year on work supervised by the Department was 2,233,855 man-months. This is equivalent to an average full-time employment of 186,155 men each month, but the number of individuals actually employed, on account of part-time employment and other reasons, averaged approximately 302,350 persons per month; and to this should be added the indirect employment supplied in the production and transportation of materials and equipment. It is estimated that such indirect employment required by the work done has averaged approximately 1.4 times the direct employment, and on this basis the indirect employment afforded during the fiscal year 1935 is estimated at 3,127,400 man-months, which, added to the direct employment, results in a total of approximately 5,361,000 man-months for the year, equivalent to a continuous average employment through the full year of 446,700 men.

Until the passage of the National Industrial Recovery Act Federal funds for road construction were expendable only on the important interstate and intercounty roads included in the Federal-aid highway system and on roads in the national forests, parks, and other Federal areas. Expenditure on city streets and local rural roads not included in the Federal-aid system was specifically prohibited by law.

### Secondary or Feeder Roads

With the primary purpose of serving the employment need, the National Industrial Recovery Act provided that a portion of the money earmarked in it for highway construction be expended on secondary or feeder roads and on extensions of the Federal-aid system into and through municipalities.

By rules and regulations prescribed by the Department the term "secondary" or "feeder" roads was defined as applying to any road not included in the Federal-aid system. Upon such roads it was required that there should be spent not more than 25 percent of the money apportioned to each State. Not less than 25 percent was required to be expended on connections through cities.

In the expenditure of the funds authorized by the Hayden-Cartwright Act increasing emphasis was placed upon secondary-road improvement by requiring that not less than 25 percent of the new apportionments should be spent on roads of that class. And, whereas a large part of the mileage improved under the earlier act had been in roads of sufficient importance to be included in the several State systems, a special effort was made to provide with the new money for the improvement of the more important local roads.

This tendency to give increasing attention to what may be called farm-service roads, as distinguished from main arteries, has been carried still further in the requirements laid down for the expenditure of the \$200,000,000 recently allotted for highway construction from the appropriation made by the Emergency Relief Appropriation Act of 1935. For purposes of this expenditure secondary or feeder roads are defined as roads not included in either the Federal-

aid or State highway systems, and it is required that not less than 25 percent of the allotment shall be spent for the improvement of such roads.

### INTERNATIONAL COOPERATION IN WEATHER STUDIES

In the work of the Weather Bureau international cooperation is a vital factor. For more than 60 years the directors of national meteorological services have been meeting regularly to exchange ideas and information and to secure harmony and standardization for effective cooperation. Meteorology is essentially world-wide in its scope. No country, whatever its geographic area, is large enough to be independent of other countries in providing its people with an adequate weather service.

The International Meteorological Organization is wholly voluntary, and not governed by treaties or conventions. Its recommendations are expressed in the form of resolutions, adherence to which is only a moral obligation. It meets once every 6 years. This year (1935) the sexennial meeting was held at Warsaw, Poland. Sub-commissions meet as frequently as circumstances warrant, usually every 2 or 3 years. Most of them met this year just prior to the major meeting. Representatives from the United States Weather Bureau were the Chief of the Weather Bureau and the Chief of the Division of Climate and Crop Weather.

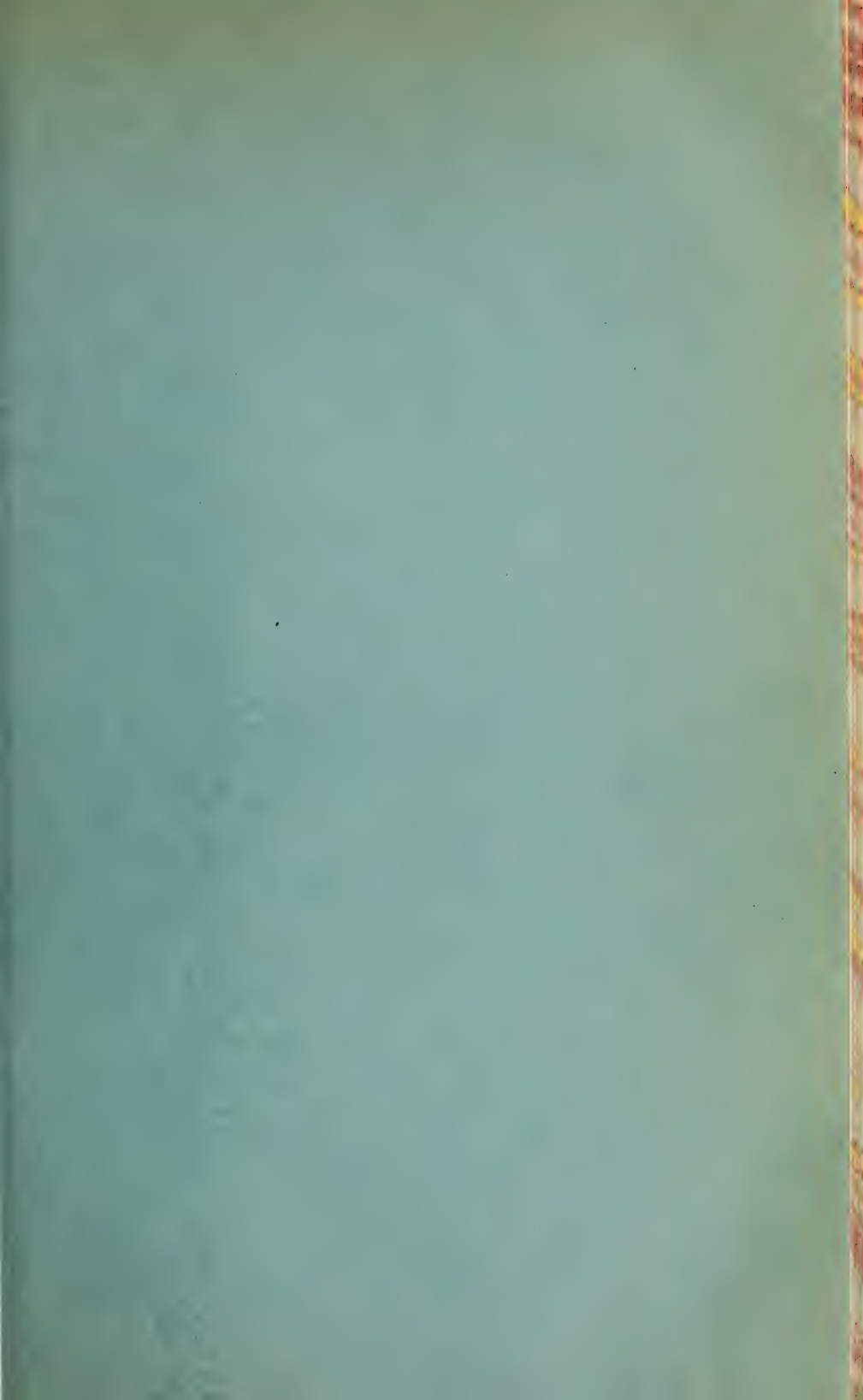
Exchange of observations is the most important feature of this international cooperation. It is done principally by radio, but occasionally by cable or telephone. Internationally standardized definitions, codes, etc., facilitate application of the data. The United States cooperates most completely with Canada. There is no meteorological boundary line between the two countries. Most Canadian reports are received at United States forecast centers as promptly as at Toronto, and observations at United States stations are as promptly sent to Toronto. Exchange arrangements also exist with Mexico, with the Philippines, with the Far East, and with meteorological organizations in the West Indies.

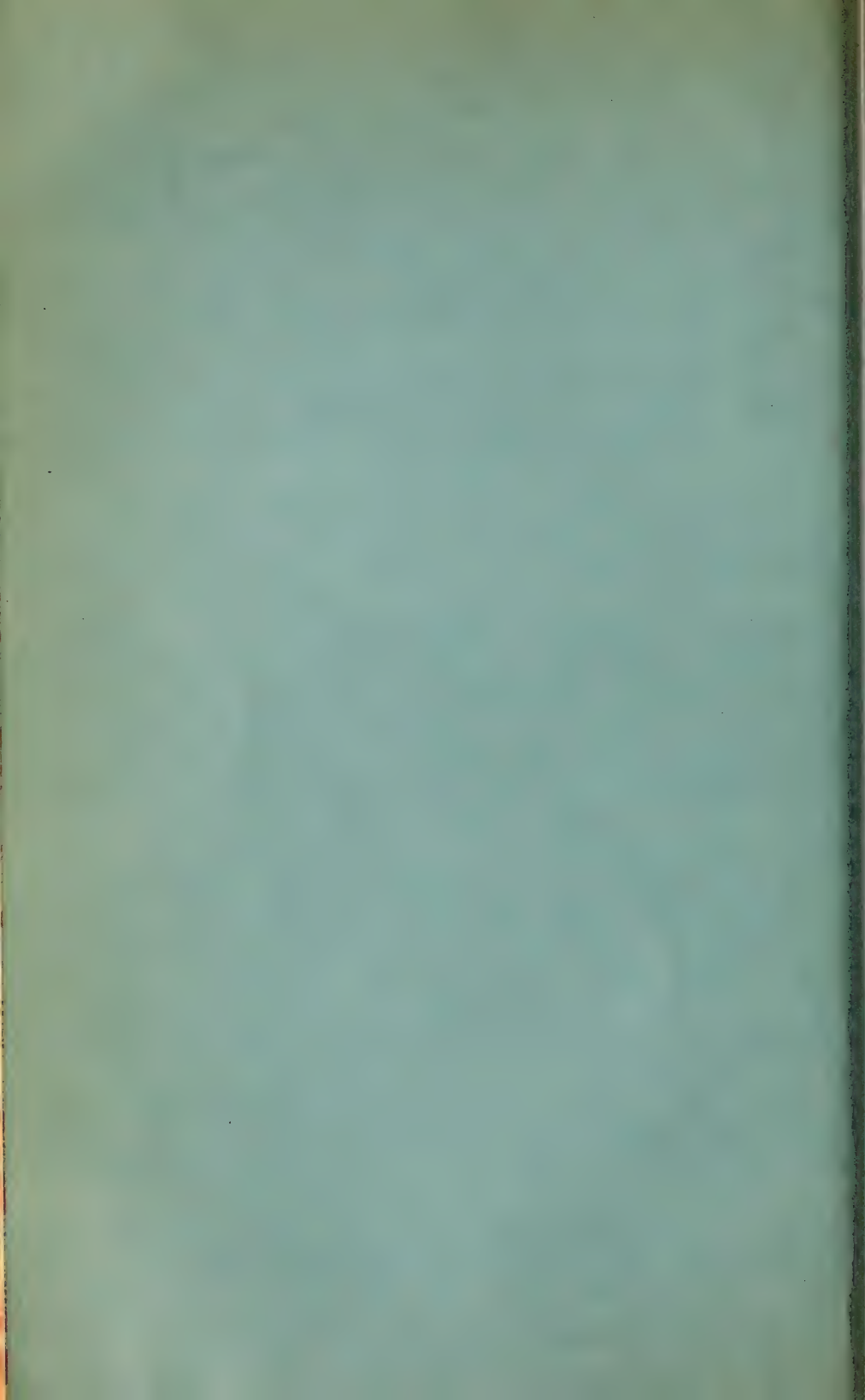
Twice each day, at 11 a. m. and 11 p. m. eastern standard time, bulletins are transmitted by radio directly from the Weather Bureau in Washington through the Navy radio stations at Arlington and Annapolis for the benefit of European meteorological services. These bulletins contain about 100 reports representative of weather conditions in North America and reports from ships in the western Atlantic. Correspondingly, twice daily, about 5 a. m. and 5 p. m. eastern standard time, bulletins containing about 100 European land-station observations and reports from ships in the eastern Atlantic are broadcast from the powerful Rugby station in England for the meteorological services in North America.

HENRY A. WALLACE.  
*Secretary of Agriculture.*











## REPORT OF THE CHIEF OF THE BUREAU OF AGRICULTURAL ECONOMICS, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF AGRICULTURAL ECONOMICS,  
*Washington, D. C., September 17, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I transmit herewith a report of the work of the Bureau of Agricultural Economics for the fiscal year ended June 30, 1935.

Sincerely yours,

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A. G. BLACK, *Chief.*

For the Bureau of Agricultural Economics, the past year has been one of increased opportunity and responsibility, growing out of the steady advances of agricultural recovery and readjustment, and the drought emergency. The public demand for current economic information, as well as for research on the numerous economic problems growing out of the changing conditions, has taxed the capacity of the staff. Not only has there been an increased load of special tasks, but the regular work of the Bureau—fact finding, analysis, administration in marketing, and like activities—has expanded. The Washington staff of the Bureau and those in the many field offices have alike contributed of their energies toward meeting the increased responsibilities and maintaining the volume of the Bureau's regular output with limited expansion of personnel.

Many Bureau activities have been coordinated with the work of the Agricultural Adjustment Administration. Many intricate problems have been studied by members of the Bureau's staff and the results made available for the adjustment programs. The Agricultural Adjustment Administration has in turn assisted the Bureau with financial aid for numerous emergency projects. The staff of the Division of Crop and Livestock Estimates was expanded to care for the additional work of supplying statistics for adjustment, a special field staff for the study of the direct marketing of hogs was provided, and numerous studies of marketing of various commodities were aided. The adjustment program has relied to a considerable degree upon the data and analyses prepared by Bureau workers who have been trained through several years of experience in assembling and interpreting statistical data with reference to various commodities and preparing outlook reports.

The outlook program, conducted in close cooperation with the Agricultural Extension Service, has led many farmers and others to think of planning their work with a view to the adjustment of production to demand. Likewise the Bureau's work in the field of land economics has been utilized as the basis for further planning for the administration of the Nation's land resources. One of the outstanding productions of the Bureau in this field culminated in the publication of the study entitled "Economic and Social Problems and Conditions of the Southern Appalachians" and in the land-utilization and land-policy section of the report of the National Resources Board.

Special mention should be made of the work of the Division of Crop and Livestock Estimates and its field statisticians in connection with the wheat, cotton, and corn-hog programs. This Division also assisted greatly in the administration of the Bankhead Act relating to cotton. The new Division of

Marketing Research cooperated constantly with the Consumers' Counsel of the Agricultural Adjustment Administration. The staff of the Division of Land Economics devoted a large part of its time to the work of the Land Policy Section of the Agricultural Adjustment Administration, later of the Rural Resettlement Administration. Later in the year the Division of Farm Management and Costs devoted almost its entire attention for a considerable time to regional-adjustment studies.

### DROUGHT-EMERGENCY WORK IN 1934

The drought of 1934 created a shortage of feed and water that extended into the winter. Many of the problems encountered by the livestock industry were of sufficient public importance to necessitate continued attention from governmental agencies. Following the preparation of several reports on the extent and progress of the drought at intervals during the summer, the Bureau made surveys during the fall and winter to ascertain the extent of the drought damage and what needed to be done to minimize its effects. Special assistance was rendered in connection with Government programs of buying cattle and sheep in emergency drought areas, such as working out the price schedules for use in making purchases and the details of operation designating the counties to be included in the emergency area, and assembling statistical information needed by administrative officials in formulating policies and planning relief activities.

In order to assist stockmen in the drought areas to carry their livestock through the winter, the Bureau, in cooperation with the Agricultural Adjustment Administration, established a Federal livestock-feed agency at Kansas City with a branch office at Amarillo, Tex. This agency assembled information as to the amount and location of feed supplies of various kinds that could be made available, advised stockmen as to where feed could be purchased at the lowest cost, and disseminated weekly reports as to current feed prices and market supply-and-demand conditions. It compiled information as to freight rates under which feed could be transported and advised with shippers and buyers as to the most economical routing of feeds to be moved. Information was supplied to stockmen regarding the nutritive value of the different kinds of feed available, and how various feeds not commonly known in the drought area should be used to obtain balanced rations for stock. Since many of the stockmen who needed feed had had little experience in buying the kinds of feed offered, the hay inspection service of the Bureau was expanded and made available to them so as to insure their being protected in regard to the quality of the hay they purchased.

As part of the Federal livestock-feed agency, a cattle-transfer unit was established for the purpose of effecting the transfer of livestock from the drought areas to sections where surplus feed was available. Lists of those who desired to sell feed or buy livestock and those who needed feed or who had livestock for sale were compiled and given wide dissemination, thus making it possible to effect contacts quickly between these various groups and bring the livestock and feed together.

Offers of feed for cattle wintering were received from farmers in 32 States; stockmen in 10 States listed cattle that had to be moved before real winter set in. As all contacts were made directly between the parties involved, there is no way of knowing accurately just what volume of livestock was shifted at the reduced drought freight rates, or how many were bought by farmers east of the Mississippi River or in Arizona and on the Pacific coast through the efforts of this office, but its services were utilized by all interested agencies and by thousands of producers. More than 400,000 cattle in excess of the normal movement went to California; over 175,000 head went from the "dust bowl" section of Texas, Oklahoma, Kansas, and Colorado to south Texas. It is known that many thousands of head went to rough feed or pasture in Kentucky, Tennessee, and the prairie belt of Mississippi, Alabama, and Georgia. Thousands of tons of rough feed were offered in the southern half of Illinois and Indiana and in Ohio, Pennsylvania, and Maryland.

The Federal livestock-feed agency was responsible for acquainting thousands of livestock feeders, State officials, county agents, and feed dealers with the best sources of supplies of feed. It is safe to say that more feed was transported by truck during the last several months than ever before during a like period.



## CURRENT-INFORMATION SERVICES

The gathering of statistics of production of agricultural products, of stocks and movements to market, of prices, foreign trade, and related subjects, is basic work of the Bureau. Increased need for more facts on all of these phases of the agricultural industry continued to increase during the year because of changing conditions. The divisions of the Bureau charged with the task of estimating crop production, the several commodity divisions gathering market news, and the foreign offices, together constitute the great news-gathering agency of the Bureau, which has carried the increased load.

### CROP FIGURES ESSENTIAL TO ADJUSTMENT PROGRAM

The Crop and Livestock Estimating service of the Bureau, under the direction of the Crop Reporting Board, continued and expanded its regular service on crop reports, farm prices, and wages, and in addition devoted a considerable part of its attention to adjustment problems.

### HELPING WITH THE COTTON PROGRAM

All available information necessary for the preparation of official estimates of cotton acreage and production in each county were compiled and analyzed. The county estimates prepared by the Bureau were used in determining county allotments under the voluntary acreage-reduction program and the Bankhead program.

The Division of Crop and Livestock Estimates has devised a method of determining the proportionate share of the county maxima of base acreage and production to which the producers who have signed offers of contracts in 1935 are entitled. The statisticians of each State have made the necessary statistical analyses for each county, under the general supervision of the cotton statistician of the Washington office.

The procedure in 1935 under the Bankhead Act provides that the Bureau again prepare the official county allotments under section 7 of the act, for the use of the State allotment boards in allocating tax-exempt certificates to individual farmers. State and county estimates of cotton production for the period 1928-32 were revised in the light of information developed during the 1934 programs, and the revised estimates were used in computing the official county quotas under the provisions of the act.

### THE RICE AND SUGAR PROGRAMS

With the inauguration of the rice and sugar program the Division of Crop and Livestock Estimates was called upon to provide a considerable volume of statistical data concerning these crops, and assistance was given in a special investigation of sugarcane prices in Louisiana during the base period (1909-13) for the use of the Agricultural Adjustment Administration in establishing parity prices in that State. A special investigation was made of rice-huller operations in Louisiana for the purpose of truing up official estimates of Louisiana rice production.

### A SURVEY OF FLORIDA CITRUS

Special funds were made available by the General Crops Section of the Agricultural Adjustment Administration for an expansion of fruit- and truck-crop estimates. Orchard-to-orchard enumeration of the numbers and acreages of citrus trees by age groups and by varieties were made, and additional data were secured on tree removals, total production, utilization, and prices received by growers. This is the first time that an attempt has been made to secure comprehensive information of this nature for entire counties. Such information will be invaluable to agencies engaged in the study of future adjustments within the fruit industry, and will be of great assistance in improving official estimates of production.

### A DAIRY PRODUCTION SURVEY

During the year efforts were made to measure currently adjustments being made by milk producers and to help dairymen plan ahead to meet the situation. This work was particularly needed because the drought caused a wide-spread

shortage of feed and forage, heavy marketings of milk cows and young stock, increased imports of butter, and increased use of butter substitutes, and brought about marked changes in feeding practices in all States.

Although these adjustments resulted in an abnormally low level of milk production during the late winter and early spring, it was important for dairymen to realize that the reduction was temporary and that it was due chiefly to a change in feeding and, to some extent, to close culling of old cows, particularly of milk cows due to freshen during the late fall months. As soon as good pasturage became available and the cows freshening in the spring and early summer came into production, milk production increased rapidly and on July 1 reached the highest level on record for that date.

The experience of last season demonstrated that the basic factors of milk production can be determined currently for the country as a whole with sufficient accuracy for most needs, but that a much more extensive service is necessary to furnish local details.

One of the features of the reports secured from dairymen that was of particular value was the quantity and kind of grain being fed to milk cows. These reports showed the regional and annual differences in the kind and quantities of feed fed to milk cows and helped to provide a basis for various estimates of normal feed requirements and for accurate forecasts of changes in livestock numbers that the drought made necessary.

#### POULTRY REPORTS REVISED

The poultry reports of the Bureau, showing annual estimated numbers by States since 1925, were revised and published. Although poultry and eggs represent one of the most important farm enterprises, no definite provision has been made to supply the industry with an adequate service of estimating.

#### SPECIAL INQUIRY ON PRICES PAID BY FARMERS

A special inquiry on prices paid by farmers was conducted with funds allotted by the Civil Works Administration, and tabulations were completed during the past year. This provided a much-needed and larger sample of retail-price information with which to strengthen the quarterly price reports of prices paid by farmers.

#### ASSISTANCE ON THE CENSUS

This Bureau cooperated with the Bureau of the Census in the analysis of data on values as of January 1935, as in previous years. Price estimates by States, prepared by the Crop Reporting Board, were used to evaluate enumerations in the census. The Census Bureau assigned clerks to handle the additional clerical work involved. Bureau statisticians helped wherever possible in analyzing census results, which in turn are used in revising estimates of production.

The regular quinquennial request for crop and livestock information was received from the Bureau of the Census, and data on average prices of crops produced and livestock products sold during the calendar year 1934 and livestock inventory values as of January 1, 1935, were supplied. In order to increase the reliability of these data, the scope of the inquiry was considerably expanded this year, and queries were sent to a larger number of correspondents.

The demand for detailed statistical production data by counties was the outstanding statistical development of the year. The personnel and facilities of the Division of Crop and Livestock Estimates have been inadequate to meet these demands except in a few States. More cooperation from the States is desirable, and the experience of the past year shows that accurate county statistics can be developed when efficient personnel has been trained. Many statistical data must be collected currently, or they will be entirely lost, since it is often impossible later to secure such data and the collection is also increasingly expensive.

#### COTTON GRADE AND STAPLE STATISTICS

Reports on the grade, staple length, and tenderability of the cotton carry-over and similar reports throughout the season on current ginnings were continued for the seventh successive season. From the season of 1928-29, when the work was inaugurated for the Cotton Belt, to 1931-32, the reports



were issued at intervals of about a month during the ginning season. Weekly reports on the crop, supplementing the regular periodic reports, were begun for States and divisions of States at the beginning of the 1932-33 season. During the last two seasons the State reports were issued from the field offices in order that the information might be more timely.

At first, in 1932-33, cooperating ginneries were furnished a copy of the daily classification sheet showing how the samples they transmitted were classed. The sheets did not carry the numbers identifying the bales from which the samples had been taken. Because of their interest in the classing activities, these ginneries agreed to furnish samples free during the 1933-34 season in exchange for daily classification sheets carrying numbers identifying the bales, although in previous years they had received payment for samples. In 1934-35 cooperating ginneries again furnished the samples free on the same basis.

#### INFORMATION ON CURRENT QUALITY OF GRAIN

A new service that has met with favorable response from practically every branch of the grain industry includes the dissemination at 15-day intervals of information regarding the quality of the various grain crops moving to market. The basic information is obtained from reports of licensed grain inspectors as the result of their official grading and certification of the new crops as they move to market. The data are carried forward cumulatively, and at the end of each 3-month period a summary is issued.

#### NEW DEMAND FOR OUTLOOK REPORTS

The several field campaigns relating to adjustment programs, covering cotton, wheat, corn-hogs, tobacco, and other commodities, created an increased demand for economic statistics and charts such as the Bureau has been furnishing to extension workers for outlook work. The fact that most of the extension workers concerned with the adjustment campaign had utilized this material in the past led them to call for more of it. The result has been that the Bureau's statistical summaries and commodity reports in mimeographed form, as well as hundreds of statistical charts, have been widely distributed. In cooperation with the Agricultural Economics Section of the Extension Service, several new forms of publications have been developed and distributed.

The annual outlook conference to prepare the Agricultural Outlook Report for 1935 was held in October at Washington with a very representative attendance from the States. The active interest in this conference has continued among State workers. Suggestions have been received that the regional outlook conferences, such as were held a few years ago before necessary economies reduced the program, be resumed.

#### MARKED CHANGE IN FOREIGN TRADE

The foreign trade of the United States in agricultural products during the fiscal year 1934-35 was characterized by a continued downward trend in agricultural exports and by a very considerable expansion, as a result of the drought, in imports of competitive agricultural products. In the fiscal year 1934-35 the physical volume of exports of agricultural products amounted to 54 percent of the annual average exports during the 5 years immediately preceding the World War, as shown by the index prepared by the Foreign Agricultural Service. This compares with 83 percent in 1933-34 and 97 percent in 1929-30. The principal factor in this low volume of exports was the decline in shipments of cotton.

United States imports of competitive agricultural products as a whole were smaller during the fiscal year than the average imports of these products during the preceding 10 years. There was, however, a great expansion in imports of certain products, such as feeds and fodder, butter, and canned beef. There were also substantial imports of durum wheat and rye, which are normally on an export basis, because of the failure of the domestic crops in 1934. The large increase in imports of the products mentioned may be attributed to the effects of the 1934 drought. Although the quantity of imports was large in relation to past trade, it is significant that it was small in relation to domestic production. In fact, the entire imports of feeds and fodder during the fiscal year represented only 4 percent of the estimated reduction of these products resulting from the drought.

As previously indicated, the total imports of competitive agricultural products were less than the 10-year average. This was true because of the relatively small imports of such products as wool, eggs and egg products, and dairy products other than butter.

#### FIRST TRADE AGREEMENTS DEVELOPED

The Bureau's specialists in foreign trade devoted a large part of their attention to assisting in the development of trade agreements. They prepared basic data and participated in the commodity and country committees that were charged with the negotiations with representatives of foreign countries.

Since the trade-agreements program contemplates reductions in American import duties in return for reductions in import restrictions affecting American products in foreign countries, it is especially important to consider the progress of this program in relation to agriculture. In the second place, as regards foreign governmental policies, it is important to consider the fundamental developments in this field as an indication of what may be expected in the way of trade barriers to agricultural products during the next few years.

At the end of the fiscal year, trade agreements had been negotiated with Cuba, Belgium, and Haiti and had gone into effect. An agreement had been negotiated with Sweden which went into effect on August 5, 1935, and agreements have been negotiated with Brazil and Colombia, but at this time (September 1935) these have not been ratified by the legislatures of those countries. From the point of view of agriculture, the most important of these agreements was the one with Cuba. As regards agricultural products, the United States made substantial concessions to Cuba on sugar, tobacco, and winter vegetables. In the cases of sugar and tobacco the United States duty was reduced, but a limitation was placed on the quantity of these products which could be brought into the United States.

In addition to the countries mentioned, with which negotiations have been completed, announcements have been made by the Department of State that negotiations would be entered into with Canada, the Netherlands, Switzerland, Finland, Spain, Italy, and five of the Central American countries. At the end of the fiscal year negotiations had not been completed with any of these countries.

Experience has not yet been sufficient to permit an appraisal of the effects of the trade-agreements program upon agriculture.

#### DEVELOPMENTS IN FOREIGN FIELD OFFICES

The principal developments in the work of the foreign offices of the Foreign Agricultural Service have been (1) a start at concentration of reporting on a commodity basis in the European offices; (2) a marked increase in participation by Foreign Agricultural Service officers at international conferences; and (3) a considerable extension in the activities of the agricultural attachés as advisers to the heads of the embassies or legations to which they are accredited. Much of the work of the foreign offices of the Foreign Agricultural Service Division in the past has been in the field of current reporting on foreign crops and foreign-market conditions. Although this activity has a definite place in the work, it has been felt that more attention should be paid to economic studies and appraisals of a broader and more fundamental nature, particularly in the field of foreign governmental policies affecting agriculture.

The outstanding instance of the marked increase in the attendance of Foreign Agricultural Service officers at international meetings is found in the continued participation of the officer in charge of the Berlin office in the meetings of the Wheat Advisory Committee set up under the International Wheat Agreement of August 1933. During the year this officer was made a delegate for the United States, whereas previously he had served as an adviser to the American delegate. Members of the Berlin staff also attended the international meeting of agricultural economists at Bad Eilsen in July 1934. The officer in charge of the Belgrade office attended the meeting of the Sixteenth International Agricultural Congress at Budapest in June 1934. The officer in charge of the Paris office attended, as an observer for the United States, an international meeting on wine held at the International Institute of Agriculture in April 1934. The Paris and Belgrade representatives attended the general assembly of the International Institute of Agriculture held in Rome in October 1934, as official delegates of the United States. The officer in charge of the Buenos Aires office



was selected as an adviser to the American delegation to the Pan American Commercial Conference held in Buenos Aires during May 1935.

Arrangements were made during the latter part of the fiscal year for the attendance of a number of the officers of the Foreign Agriculture Service as observers or representatives of the United States at international meetings to be held during the coming fiscal year.

#### AMERICAN-GROWN COTTON IN JAPAN

Findings of the cotton specialist of the Foreign Agricultural Service, who was stationed in Japan for more than 2 years, formed the basis of a preliminary report issued on the subject of the consumption of American and other growths of cotton in Japan. Rapid growth in the importance of the Japanese market for American cotton is shown, and the report indicates as definitely as possible the competition encountered by American cotton from growths of other countries.

The study reveals the great importance of the relative price between American and other cotton in determining the quantity of the former that will be consumed by Japan, although American cotton must be used for certain of the finer counts of yarn. The study attempts to show, as nearly as possible, the price at which different classes of American cotton will be substituted for Indian or Chinese cotton and vice versa.

In general it is concluded that American cotton is especially desired for use in the manufacture of cotton goods for export, and that the continued expansion of the Japanese market for American cotton will depend to a very large extent upon Japan's ability to maintain or increase its large cotton-textile trade. But even though Japan's exports should continue to expand, this would not necessarily mean larger total exports of American cotton, since to a considerable extent Japanese goods would be replacing goods from other countries which have been made from American cotton.

#### BRAZILIAN COMPETITION IN COTTON

A field investigation has been made of cotton production in Brazil. The resulting report on cotton production in southern Brazil shows that so far as land and climate are concerned southern Brazil has great potentialities for cotton production. But there are numerous disadvantages, such as the relative shortage of labor and inadequate facilities for physical handling of cotton, and wide-spread plant diseases and insect infestation are considerable handicaps. Certain of these disadvantages, such as the facilities for handling cotton, are being overcome rapidly, but other problems have still to be faced. The report brings out the great importance of the competition between coffee and cotton in determining the quantity of the cotton that may be raised in southern Brazil in the years immediately ahead. It seems clear that there is insufficient labor to take care of the production of both cotton and coffee on a large scale. Moreover, if returns were at all adequate, most of the agriculturists would prefer to raise coffee, as it is the established industry of the region. Coffee prices, however, continue at extremely depressed levels.

#### STUDIES OF FOREIGN AGRICULTURAL POLICIES

The trend toward increased intervention by governments in the field of agriculture continued during the period under review. There were a number of instances of changes in governmental measures, in accordance with experience accumulated during recent years. The Foreign Agricultural Service Division has endeavored to follow the more significant developments in this field and in certain cases has made special studies, the findings of which have been published in the weekly publication, *Foreign Crops and Markets*.

During the year a comprehensive report, *Agriculture in Southern Africa*, was published. This bulletin embodies the results of studies and investigations made by the representative of the Foreign Agricultural Service stationed in Pretoria as agricultural attaché during 1931 to 1933. It gives as complete a picture as is possible from available information as to the present situation with respect to various lines of agricultural production in the African countries south of the Equator and attempts to indicate the lines along which it seems most probable that future developments will move. In general, the following conclusions are reached as to probable agricultural developments in this

region: A decrease in the production of wool, mohair, and exportable corn; an increase in the production of cattle, citrus fruit, deciduous fruit, and sugar; a probable increase in the production of cotton and tobacco, especially by natives in countries south of the Equator, with the exception of the Union of South Africa. Of the most direct significance to the United States are the probable increases in the production of fruit and tobacco, as these products now compete actively with similar American products in European markets.

#### REPORT ON THE CHINESE MARKET

The Shanghai office has prepared a number of special reports analyzing the factors affecting agricultural exports to China. Most of these studies have been on an individual commodity basis, but one report, *Tendencies in China's Agricultural Exports and Imports and Effect on American Products*, has endeavored to bring together the fundamental factors that are influencing the Chinese outlet for our products.

#### STANDARDIZATION AND INSPECTION OF FARM PRODUCTS

A significant phase of the standardization and grading work this year has been the increased interest on the part of consumers and consumer organizations. Recognizing this trend and its importance in the success of our work, the Bureau this year, for the first time, sent an exhibit showing the use of quality standards in the labeling of products for consumer use to the annual meeting of the American Home Economics Association, and received an immediate request for a similar exhibit at the forthcoming meeting of the American Dietetic Association. Work on standards which will be of practical use to consumers, and evidence of which can be carried through to them by means of some device or label, is being pushed more effectively than heretofore.

#### USE OF OFFICIAL COTTON STANDARDS

A total of 2,214 boxes of the standards for grade, including 146 boxes of the tentative preparation standards, were distributed during the year. The number of staple types distributed was 6,953, an increase over the number last year.

Thirty-four copies of the official standards for American cotton linters and 66 expositor types were issued. The Board of Cotton Linters Examiners passed on 867 samples, representing approximately 200,000 bales. In the verification of the weekly prices reported by other cooperating agencies with a production of more than 200,000 bales, 326 samples were classified. Questions as to the quality of the filling used in contracts for more than 1,000,000 mattresses, contracted for by various branches of the Federal Government and State agencies, were referred to the board for settlement.

Cotton-standards demonstration schools were held throughout the Cotton Belt, as during recent years, in cooperation with colleges, State and county agencies, and cooperative associations. The purpose is primarily to demonstrate to cotton growers the application of the official cotton standards in the classing of the grades and staples grown in the greatest abundance in their communities, but much interest is evidenced by students, teachers, county agents, and others of varying experience—some hoping to qualify as licensed classers, others wishing to obtain a general knowledge of cotton classing.

#### CHANGES IN STANDARDS FOR GRADES OF COTTON

The annual color survey of the American cotton crop was made again. Data for four seasons have now been accumulated. Thousands of samples from the Cotton Belt have been checked by careful color analysis and by extensive classification studies. Combined results showed definitely that changes in the color of the crop during recent years have been toward White cotton and that most of the cotton crop now falls in the White and Extra White, Strict Middling, Middling, and Strict Low Middling grades, with the highest grades tending toward Extra White and away from the creamy or "buttery" color.

On a basis of the accumulated data from precision measurements in the color laboratory, supported by classification data and other considerations, a revision of the official standards of the United States for grades of cotton was proposed by the Bureau for consideration under the Universal Standards



agreement, and the proposed standards were displayed to representatives of the principal cotton associations, American and foreign, operating under and/or affected by the agreement. The revised standards were promulgated by the Secretary of Agriculture on August 20, 1935, effective August 20, 1936. They will be used in the preparation of key sets for consideration at the international Universal Cotton Standards Conference to be held in Washington in March 1936.

In brief the changes make the White grades more representative of the cotton crop; they eliminate grades for types of cotton that have become scarce; they provide for so arranging the samples within the grade boxes as to facilitate better use of the standards; and they so affect the Yellow Tinged and Stained grades that the Tinged grades no longer carry so deep a color as formerly, and the Yellow Stained grades cover all cottons that are deeper in color than Tinged.

#### NEW GRAIN STANDARDS IN EFFECT

The new and revised official grain standards of the United States, which became effective July 1, 1934, have now been given a year of steady use in commercial life and are proving to be generally satisfactory. Certain minor amendments have been promulgated, designed primarily to improve and facilitate the inspection practice of the licensed inspectors and grain supervisors.

Research aimed to devise an automatic mechanical sieving device that would improve the accuracy and uniformity of grain inspection by determining the quantity of dockage and foreign material in grain was concluded, the usefulness and accuracy of a model device was conclusively proven, and a contract was awarded to a manufacturer for a sufficient number for the purposes of Federal grain supervision.

Research for the purpose of improving equipment and methods of procedure for quick and accurate determination of the oil content of flaxseed was begun in cooperation with several State agricultural colleges, linseed-oil crushers, and paint or glass manufacturers. Preliminary work indicates material variations in the equipment, methods of procedure, and results obtained in such determinations, and shows the need for a standardization of methods and equipment used in such determinations.

#### CONSERVATION OF GOOD SEED GRAIN

To combat the devastating effects of the drought, the Commodities Purchase Section of the Agricultural Adjustment Administration undertook to conserve seed-grain stocks for future use in the areas most afflicted. Cooperating in this work, the sampling, inspecting, and grading of stocks of grain to be procured and conserved as seed was done by this Bureau. A total of about 20,000,000 bushels of grain was inspected and graded, and official certificates were issued later and used as a basis of commercial transactions in the negotiations for the purchase and warehousing of these seed grains. Later, the Bureau supervised the cleaning and preparation of these seed stocks for distribution.

#### HAY, FEED, AND SEED INSPECTION SERVICES

The hay-inspection service was chiefly directed toward assisting in meeting the emergency feed situation created by the unprecedented drought of 1934, which extended over almost the entire hay-producing and hay-consuming territory of the central part of the United States.

Effort was made to have all the hay shipped into drought areas inspected. Ten emergency inspectors, employed in cooperation with the Agricultural Adjustment Administration, were placed in emergency drought States and at surplus shipping points, as needed, to inspect hay to be shipped to or received by drought-stricken States as emergency feed. Hundreds of thousands of tons of hay and other roughage were thus informally inspected by emergency inspectors.

In connection with the forage-conservation campaign conducted by the Agricultural Adjustment Administration, inspectors' training schools were conducted in Iowa, Illinois, and Tennessee to qualify emergency inspectors to inspect corn fodder, soybean hay, and lespedeza hay. More than a hundred men so trained were licensed.

For the second consecutive fiscal year the seed-verification service broke previous records for the number of dealers enrolled, the quantity of seed verified as to origin, the number of inspection certificates handled, and the total amount of fees collected. The service continued to be on a self-supporting basis.

#### PROGRESS IN STANDARDS FOR LIVESTOCK

Definite progress has been made in standardization work with livestock. Standards for the grades of hogs, drawn by the Bureau in cooperation with leaders in the industry are now used by a large number of packers and others who buy direct from producers in the hog-producing areas, and a revision of these standards based on practical experience is under way. Market classes and grades of sheep and lambs are outlined, defined, and illustrated in a manuscript prepared during the year. Definitions and illustrations of the market classes and grades of stocker and feeder cattle were issued tentatively, together with colored posters illustrating the six grades of feeder and stocker cattle, and submitted to those directly interested in such cattle, with the request that they offer criticisms and suggestions. The grade descriptions for slaughter barrows and gilts have been prepared and those for sows are being written.

#### INCREASE IN QUANTITY OF MEAT GRADED

As usual, beef comprised the major portion of all meats graded, and totaled 252,351,000 pounds. The quantities of veal and calf, lamb and mutton, fresh pork, cured beef, sausage products, and other miscellaneous meats graded increased. The total of all meats graded was approximately 8,000,000 pounds more than in the previous year. The grading and labeling of sausage and related prepared meat products in such a way that the consumer can ascertain the grade was begun this year. Through an extension of the cooperative agreement with the National Live Stock and Meat Board it was possible to employ more graders than previously.

An interesting development of the year was the enactment of a city ordinance in Seattle making it mandatory that all beef, lamb, and mutton sold in that city be graded according to the standards of this Bureau under the immediate supervision of a Bureau grader.

#### IMPROVEMENT OF WOOL STANDARDS AND GRADING

Research pertaining to standardization of wool is directed toward improvement and extension of the present standards. Investigations of the diameter distribution in the grades and further studies of the length factor were made.

A comprehensive program of measurement of fibers of carefully selected samples of wool and wool top is being attempted with the objective of developing a key for grade determination, based on the distribution of fiber diameters in the grades. The microprojector is used in connection with wedge rulers. The image of the fiber is projected, magnified 500 times, onto the scale, thus permitting a calculation of the diameter value at the points of tangency of the image on the wedge rulers. Devices have lately been obtained for the projection of cross-sectioned groups of fibers that photomicrographs may be made for auxiliary study and cross-section and fiber-width measurements.

The auction-sale method of marketing wool long used in other countries has not been considered suitable to conditions in this country. An organization that is attempting to introduce the auction-sale method into the United States launched a broad-scale plan this year for auctions at Ogden, Utah, and obtained the cooperation of this Bureau in the supervision of the grading of the wool. Indications are that the accumulation for the auction sales this season will approach or exceed 3,000,000 pounds of wool.

In four important wool-producing States, educational work through lectures and demonstrations was conducted at a series of 43 county or district meetings held under the auspices of the wool-marketing organizations, and there were requests for assistance from several other States.

#### INSPECTION OF FRUITS AND VEGETABLES

During the fiscal year 306,441 cars of fruits and vegetables were inspected at shipping points and 53,443 cars in receiving markets, a total of 359,884 cars.



This represented an increase in cars at destination markets but a decline in cars at shipping points, caused chiefly by the smaller number of inspections in Florida under the marketing agreement which was in effect during a portion of the shipping season and by the reduced potato production in Colorado, Idaho, and Minnesota on account of the drought.

Practically all of the inspections under the Export Apple and Pear Act is done at shipping points. As usual, an inspector was stationed at Montreal from July 15 to November 10 in order to issue the clearance certificates required by the special British import act which forbids the entry during that period of barreled apples that are not U. S. Fancy or No. 1 or boxed apples that are not Extra Fancy or Fancy.

The standards for several fruits and vegetables were revised in accordance with further study and experience.

#### GRADING OF CANNED FRUITS AND VEGETABLES

The total volume of canned fruits and vegetables graded during the year was well over 5,000,000 dozen cans, calculated as no. 2 size.

This quantity includes commercial gradings for State, county, and city governments and for Government departments, but does not include stocks of merchandise stored in warehouses licensed under the United States Warehouse Act, samples from which are forwarded to this Bureau so that the accuracy of the licensed inspectors may be checked. The licensed capacity at the close of the fiscal year for such warehouses was more than 3,000,000 dozen cans.

In addition, samples drawn from nearly 3,000,000 gallons of cider vinegar were inspected.

Standardization research studies have included the development of methods for determining turbidity of liquor in certain vegetables, determining color standards for certain products by means of the improved color analyzer, and developing practicable instruments for determining the maturity of certain canned products, such as canned corn.

In cooperation with the National Recovery Administration, a brief study was made of the official labeling of canned goods under the Canadian Meat and Canned Foods Act of 1927. A joint report covering the findings was published by the Consumers Advisory Board.

Practical endorsement of the work of establishing official grades for canned fruits and vegetables occurred in the announcement by one of the largest food-distributing firms in the country that it would use the officially promulgated grades of this Bureau on some of their labels experimentally. This was done in January, and the experiment has been considerably extended during this year's pack. Another large food organization, through its committee on standards and labels, recommended the adoption of the standards for grades officially promulgated by this Bureau for several canned commodities and suggested amending the code of fair competition for the grocery industry in such manner as to make mandatory the labeling in the terms of Federal grades. The largest food broker on the eastern seaboard has advised the canned-foods trade that his sales henceforth would be made on the basis of Federal grades and that the practice of submitting samples to prospective buyers would cease.

#### GRADING SERVICE ON BUTTER AND EGGS

The work of grading and inspecting dairy and poultry products expanded somewhat during the year. The grading service on turkeys was extended to a larger number of shipping points in the Northwestern States and to several points in Texas.

An increase was shown in the volume of butter and eggs packed under certificates of quality and in the number of firms that applied for this use of the grading service.

Tentative grades for churning cream were formulated and issued as a basis of discussion and suggestion and have been put into limited use. Complete tentative revision was made of the United States standards and grades for butter; this revision will be made available for criticisms and suggestions.

Revision has been made of the United States standards for American cheese and will soon be issued for discussion.

## INSPECTION OF TOBACCO AND SORTING DEMONSTRATIONS

Tobacco-inspection operations this year involved the largest total of tobacco inspected in any year except the fiscal year 1934. During the fiscal year 1935, 160,532,000 pounds of farmer-owned tobacco were inspected and 39,825,000 pounds of hoghead tobacco in storage, more than 200,000,000 pounds in all.

Tobacco-sorting demonstrations were given at 74 meetings in an effort to bring about greater uniformity of sorting tobacco before it is offered for sale. As progress made in eradicating the mixing of grades should be reflected in improved prices paid to growers and as there is a demand for this activity, the work should be established on a wider basis in the future.

## THE MARKET NEWS SERVICE

The unusual and frequent change of prices of farm products during the year has maintained the demand for current market-news reports. The Bureau's Nation-wide service was continued on about the same scale as in 1934. The leased-wire system covered about 9,000 miles, giving instant communication between about 50 offices in the principal market centers and a large number of short-time field stations. The number and variety of releases issued by the various offices were maintained and, with some commodities, slightly increased. The cooperation with States having active bureaus of markets was continued, as in New York, Pennsylvania, Virginia, Wisconsin, Oklahoma, Texas, California, Florida, and North Carolina. It is to be noted, however, that State bureaus of markets are not increasing in number and that the activities of those in several States have been restricted in recent years.

The outstanding example of regional cooperation in market news is the New England radio news service at Boston. On this project the departments of agriculture of each of the six New England States and the local radio station WBZ cooperated with this Bureau to provide a working budget and maintain a local broadcast program of market news and other economic information, especially prepared for New England farmers and the trade, and broadcast twice daily. This program has been in operation for 7 years and is vigorously supported by New England States. As a demonstration of their interest, this year when increased support was needed, the several New England States increased their contributions from \$1,275 to \$2,450.

The Bureau continued its cooperation with the Iowa Agricultural College at Ames, Iowa, which broadcasts a complete program of market news secured from a drop on the leased wire. The Oregon Agricultural College performed a similar service for that State. The San Francisco market news is included in the program of the Western Farm and Home Hour, which is broadcast over a number of Pacific Coast stations. Economic information used on the Farm and Home Hour over the National Broadcasting System chain was somewhat increased during the year as the amount of emergency broadcasting tended to decline.

## LIVESTOCK, MEATS, AND WOOL NEWS

Full-time livestock-market reporting offices have been maintained at 23 important public livestock markets, meat-market reporting offices have been operated at five market centers, and the wool-market reporting service has continued at Boston.

Among newer lines of work, the Des Moines office is maintained primarily to collect and disseminate information relating to the direct marketing of hogs in interior Iowa and southern Minnesota. Purchases of hogs at 9 interior meat-packing plants and sales at 22 hog-concentration yards are included in the reports compiled and released daily by that office. Leased-wire service for more general market news at Nashville was extended from 3 months to 6 months, and arrangements were made for extending the wire service at San Antonio to cover the entire year and for increasing the number of reports to be issued at Buffalo.

Development of the radio-broadcasting service at Cincinnati over station WLW, the most powerful in the country, necessitated the appointment of a marketing specialist to assist in the twice-daily market reporting and other work at that office, and the leased wire was installed in the Bureau's office. Approximately 100 radio stations, in all sections of the country, regularly broadcast market-news programs prepared by the Bureau.



All newspapers that are affiliated with or subscribe to the telegraphic services rendered by the Associated Press, the United Press, and the International News Service, received daily and weekly livestock- and wool-market reports prepared by the Bureau, especially for distribution by such agencies. More detailed market reports were prepared daily, especially for the use of a number of metropolitan newspapers published at important market centers, and weekly and periodical reports were prepared for numerous trade and agricultural publications. Several market-reporting offices also maintained mailing lists of country newspapers not served with current market news by press associations. Such publications were served regularly with weekly or semiweekly market reports usually prepared especially for such news-distributing agencies.

The Western Union and Postal Telegraph Cos. used the Bureau's market reports for dissemination to subscribers to their livestock commercial news dispatch services at all livestock markets reported by the Bureau.

#### THE NEWS OF FRUIT AND VEGETABLE MARKETS

The market-news service on fruits and vegetables was continued along the usual lines through the twentieth consecutive year of operation.

From Washington and the 21 market stations and 42 field offices more than 11,000,000 mimeographed market-news reports and other special reports were issued during the calendar year 1934. This decrease of about 92,000 from the figure of the preceding year was due to curtailment of the service by the elimination of the market station at Salt Lake City. The total number of names on all mailing lists on June 30, 1935, was 38,004 for market stations and 37,425 for field stations, or a total of 75,429.

The transportation companies continued their valuable cooperation in furnishing daily telegraphic reports of car-lot shipments, in addition to monthly mail reports on the basis of billing stations. About 834,592 cars of 46 leading fruits and vegetables were reported shipped during 1934, which was an increase of approximately 35,984 cars from the figures of the year 1933, or an increase of about 4 percent.

About 42 products were reported telegraphically by the carriers in 1934, and 4 additional products were reported by mail. Daily shipment reports were published on all of the 46 products reported telegraphically by the carriers.

The cooperative arrangement relating to shipments and destinations, in effect with the California grape industry for 8 years, was continued, as was a more modified arrangement on citrus fruits for Florida interests, in effect for the last 4 years.

The Bureau's 9,000 or more miles of leased telegraph wires continued to be used for rapid collection and dissemination. In addition to the year-round offices, the field station at Waupaca, Wis., and certain State offices in the southern part of the country were given leased-wire service during the period of their operation as market-news offices. This service is discontinued at certain stations during seasons when it is not needed.

An important source of fruit- and vegetable-market information has been the unload reports now received from 66 cities. The railroad agents and boat and express companies continue to cooperate in making these reports. Records of motor-truck receipts are obtained whenever possible and included in the summaries.

#### COTTON MARKET NEWS SERVICE

Field offices have been maintained at Atlanta and Memphis in connection with the cotton market-news service. The Atlanta office served North Carolina, South Carolina, Virginia, Florida, Georgia, and Alabama. The Memphis office served Tennessee, Mississippi, Arkansas, Louisiana, Missouri, the small cotton-producing areas in Kentucky and Illinois, and in a limited way the States of Texas and Oklahoma. The distribution from both offices increased considerably. Mail, radio, and the public press were used.

The weekly cotton-market review, prepared at Washington and based on information assembled at Washington from six field offices in the South and a correspondent in New England, was telegraphed as usual from Washington every Saturday morning, and was mimeographed in Atlanta and Memphis and mailed so that it reached readers by early Monday morning.

**GRAIN, HAY, AND FEED MARKET NEWS**

The grain- and feed-news services are Nation-wide. The rice-news service is confined principally to the southern belt and the Pacific Coast, a market-news service on hops serves principally the west-coast area including Washington, Oregon, and California; the service on beans is confined chiefly to California and is conducted in cooperation with the State Department of Agriculture, and a news service on alfalfa covers the Central and South-western States and the Pacific coast.

**INFORMATION ON THE SEED SITUATION**

Short seed crops caused largely by the severe drought stimulated great interest in the reports of the seed-reporting service. Urgent requests for information were made earlier and in larger number than ever before.

During the fiscal year 65 reports on 25 kinds of seed were issued, as compared with 42 reports the preceding year. Approximately 39,000 copies of these reports were sent to farmers, country seed shippers, wholesale and retail seedsmen, banks, railroads, seed-trade and farm papers, colleges, State departments of agriculture, etc. The Press and Radio Services of the Department disseminated more of the information in those reports than usual.

The price and movement reports, discontinued temporarily last year, were restored. They enabled seed growers, country shippers, and seedsmen to keep in close touch with the seed situation in important producing districts while the various kinds of seeds were moving from the hands of the growers.

The acute shortages of a number of seeds were made known in the situation reports before many growers had sold their seed, and in the cases of a few kinds of seed that information was furnished in advance of harvest so that the growers might save as much as possible. Even fortified with this information, growers were unable to produce nearly enough of certain kinds of seed (particularly timothy, Sudan grass, and millet), to take care of the normal planting requirements of this country. The larger seedsmen, relying upon the information disseminated by this service, met the situation by importing the largest quantities of these seeds on record.

**MARKET NEWS REGARDING DAIRY AND POULTRY PRODUCTS**

Considerable quantities of butter were received in domestic markets from foreign countries during the first half of the calendar year because of a more favorable price situation in this country. Arrangements were made to provide periodic reports on prospective shipments of butter to the United States from New Zealand and from European countries. This information was available by cable once each week, and information was also provided regarding foreign wholesale prices for butter. Wide interest in this type of information was noted.

The usual information services regarding statistics of production, stocks, prices, and consumption of dairy and poultry products continued to be used in connection with Federal emergency activities as well as by the regular trade.

**REGULATORY SERVICES****COTTON FUTURES ACT AND COTTON STANDARDS ACT**

In general, the work under the United States Cotton Futures Act continues to include the grading and stapling of all cotton delivered in settlement of futures contracts, the supervision of the determination of spot quotations and commercial differences in markets designated by the Secretary of Agriculture as bona fide spot markets for the purposes of the act, the cotton-standardization work, and the cotton market-news service.

The classifying of cotton under the Cotton Futures Act is done in accordance with section 5 of the act, which requires that all cotton intended for delivery on futures contracts entered into in accordance therewith shall be classified and certificated by officers of the Department.

It has not been profitable during the fiscal year for trade members to deliver any considerable quantity of cotton in the settlement of futures contracts. The total number of bales certificated on original classification was only 6,362. Reviews numbered 11,239 bales.



A feature of the work under the Cotton Futures Act was the demand upon the boards incident to the withdrawal and cancellation of 167,605 bales of certificated cotton. Whereas on July 1, 1934, the total of the certificated stocks at the various future-contract delivery points numbered 208,998 bales, on June 30, 1935, this figure had been reduced to 43,282 bales, and according to information at hand the Cotton Producers' Pool had acquired almost 30,000 bales of this remaining total with the intention of de-certificating it.

#### GRAIN STANDARDS ACT

Nineteen years of administration and enforcement of the Grain Standards Act have now been completed. This legislation has remained in force since 1916 without amendment. Its administration involves both service and regulatory activities, and under its terms the Secretary of Agriculture has established uniform grain standards and inspection for use in domestic and export commerce.

At the close of the fiscal year 1935 grain inspectors were licensed under the act, and inspection service was available at 176 points in 33 States. The sampling, inspection, and grading work of these licensees was supervised by the Bureau through 45 field offices located at the important grain markets and through two boards of review located at Chicago, Ill., and Portland, Oreg. Licensed inspectors, operating under the supervision of Federal district supervisors, performed official inspections during the year on approximately 1,185,062,000 bushels of market grain of all kinds in railroad cars and vessels. Federal grain supervisors handled a total of 30,004 appeal inspections, which covered approximately 6½ percent of the total volume of grain inspected. In addition, 185 appeal inspections, covering 1,500,000 bushels of grain, were handled under the Warehouse Act. For the purpose of maintaining accurate and uniform application of the grain standards among Federal district supervisors and licensed inspectors, the boards of review at Chicago and Portland passed upon 45,497 samples of all kinds of grain which presented difficult problems in the interpretation and application of the standards.

#### WAREHOUSE ACT

The administration of the United States Warehouse Act consists primarily of licensing warehousemen, storing agricultural products, and supervising their operations after they have been licensed. By the close of the year approximately 961 warehousemen had been licensed, some of whom may operate several warehouses at the same point.

The Department plans to make four inspections of each warehouse annually: this now means at least 3,844 inspections each year. The inspections are complete audits of stocks in warehouses as compared with outstanding receipts, and examinations are made on each inspection to determine that all receipts that may have been issued or surrendered have been properly satisfied.

During the year steps were taken to prohibit the excessive and repeated sampling of cotton in warehouses licensed under the act. This action has received the support of growers, warehousemen, insurance interests, and merchants. In the work with underwriters further progress has been made toward securing a policy for federally licensed cotton warehousemen that will automatically give licensed warehousemen full insurance coverage as long as they have any legal liability. In April examiners of the Division of Warehousing made an inventory of stocks of rice in warehouses and mills in Arkansas, Louisiana, and Texas, at the request of the Agricultural Adjustment Administration, and in other ways assistance has been rendered in warehouse matters in connection with the work of the Agricultural Adjustment Administration and the National Recovery Administration.

#### PRODUCE AGENCY ACT AND PERISHABLE COMMODITIES ACT

The Perishable Agricultural Commodities Act has been in effect since 1930. Certain amendments became effective in April 1934. The Produce Agency Act has been in effect since 1927. These two acts are administered by the same organization unit since they both relate primarily to the suppression of unfair practices in the handling of fresh fruits and vegetables in interstate commerce.

The outstanding features of the year's work are the increase of about 5 percent in the number of complaints filed under the Perishable Agricultural

Commodities Act; the closing of approximately 62 percent of all cases as a result of action taken by the Bureau, fully one-half of them being amicable settlements; known payments of \$172,196.52, resulting from amicable settlements since April 13, 1934; and the reduction of the number of formal hearings held to less than one-half of the number held the previous year and the consequent increase in the number of decisions rendered without formal hearings. The number of licenses issued and the number of licenses terminated have increased considerably, but the net increase in the number of licenses in effect is small. The number of cases handled under the Produce Agency Act has been considerably reduced.

#### STANDARD CONTAINER ACTS

Fruit and vegetable containers that are subject to the provisions of the Standard Container Acts are manufactured by 398 manufacturers located in 32 States. As in many instances manufacturers make more than one type and more than one size of each type, and occasionally more than one style of the same type, the number of separate items with which this Bureau has to deal is several times larger than the number of manufacturers.

The routine effort of the Bureau has continued to be directed largely toward maintaining an accurate index of manufacturers, following up delinquents, securing the necessary corrections in containers, and obtaining approval of specifications where this factor is involved. Special effort has been made this year to clear up cases of delinquency and pending specifications.

#### GENERAL ECONOMIC RESEARCH

The regular research of the Bureau was continued practically unabated throughout the year notwithstanding the claims of the acute special and current problems which necessarily demanded much immediate attention. Emergency conditions have prompted a review and replanning of a not inconsiderable part of the Bureau's research program to align it with changing conditions.

#### A NATIONAL PROGRAM OF COTTON RESEARCH

The cotton research being done by various bureaus of the Department of Agriculture and in cooperation with the State experiment stations in the cotton States was reviewed during the year. This Bureau, with others in the Department, prepared a detailed outline of various projects, specifying the objectives, research completed or in progress, and results. Special consideration was given to the need for further research in the field of cotton research. This survey served to show the scope of present cotton research, which covers a large number of different projects, ranging from problems of breeding and production through harvesting, ginning, marketing, spinning, finance, etc.

Following the preparation of the outline of cotton research, conferences were held with representatives of the agricultural experiment stations of the cotton States, and plans were laid for closer coordination of future research. It is believed that steps have been taken which will lead to a more productive program in this field in the near future.

#### PACKAGING COTTON

A study of baggings used to cover cotton bales and the cost to growers of baling and wrapping cotton was completed during the year, and the results have been published.

The results of this study show that in the season 1933-34 approximately 61 percent of all American cotton bales were covered with new and re woven jute baggings, about 26 percent with sugar-bag cloth, less than 8 percent with second-hand baggings, less than 5 percent with baggings made wholly or in part of sisal; a negligible number were covered with baggings made wholly or in part of cotton.

The type of bagging used depends somewhat upon regional customs and situations. New and re woven jute baggings found their most important use as a covering for cotton bales in the central and western parts of the cotton-producing areas of the United States. The southeastern and central States of the Cotton Belt were the principal users of sugar-bag cloth. The use of second-hand and miscellaneous types of bagging was confined chiefly to the



southeast. Baggings made wholly or in part of sisal were used to a limited extent throughout practically the entire Cotton Belt.

Progress is being attained in the microanalytical studies conducted in informal cooperation with many institutions. These studies are outlined with respect to properties of importance in the marketing of raw cotton, as well as in the manufacturing of yarns and fabrics. Microscopic, ultramicroscopic, microchemical, and X-ray methods reveal previously unknown phases of the properties, characteristics, and structure of cotton fibers that contribute to the character and spinning utility of cotton.

Ginning and spinning studies conducted in cooperation with the Bureau of Agricultural Engineering and other agencies are bringing concrete results. For example, the effects of gin-saw speed and seed-roll density on cotton lint and on gin-stand operation have been formulated and are now in press, and the same is true of the effect of artificially drying seed cotton before ginning on certain quality elements of the lint and seed and on the operation of the gin stand. The experimental cotton gin at Stoneville, Miss., is visited by farmers and ginnermen who are interested in this work and who are the ones to put the result into practical operation.

The research on which many of our newer cotton studies are based has been made possible through special techniques and devices developed in the Bureau. They include an instrument for the determination of the strength of fiber attachment to the seed, an apparatus for the reading of single-strand strength determinations recorded on charts, an instrument for the elimination of foreign matter from small samples of seed cotton, an apparatus for the elimination and fractionation of foreign matter from small samples of ginned lint, a special electric-lamp housing for use in laboratories with conditioned air, a scheme and specifications for the classification of notes; and refined and special technique in the handling of samples for microscopic and X-ray analysis.

Work on the utilization of cotton in this and other countries includes studies of the comparative life of various articles made of cotton and of other fabrics.

Research studies are being prosecuted in connection with the grade and staple estimating work, including such projects as the measurement of variation in staple-length distribution as shown by samples used in this work and by samples classed for the annual carry-over report.

#### REPORT ON THE WORLD COTTON SITUATION

A comprehensive survey of the world cotton situation was begun early in the year. A section of the study dealing with production in foreign countries was released in a preliminary report. Other sections dealing with production in the United States, factors affecting demand, income, and prices are in preparation.

#### THE REGIONAL-ADJUSTMENT SURVEY

The project on regional adjustment in farming claimed much of the attention of the research personnel in the Division of Farm Management and Costs. This project, conducted in cooperation with the agricultural experiment stations of all the States and with the Agricultural Adjustment Administration, aimed to secure a more definite basis for agricultural adjustment in accordance with conditions prevailing in the different types of farming areas. It has been recognized that adjustments in acreage and production in all areas, by a given percentage from a base period, present certain difficulties, although as a basis for an emergency program, such adjustments proved markedly successful in meeting the acute surplus problem confronting the Agricultural Adjustment Administration at its inception. The difficulty was that the same degree of change in production in different areas failed to take into account those fundamental differences in farming.

Research workers in the Department and in the experiment stations, in the economic fields, as well as in the more technological fields, such as animal husbandry and agronomy, have accumulated a large fund of information and in most parts of the country have formulated certain recommendations for adjustment and improvement in farming. It was thought that if this information and the judgment of these specialists were brought together and analyzed, the results would indicate in a general way the quantitative adjustments, if the changes indicated by these data and by the judgment of these specialists were actually made.

Consequently, the project set out to determine what would be the resulting approximate acreage and production in the different States and sections if those changes in farming were made which are indicated as desirable in the light of good farm management and soil conservation. By using the results of the Bureau's previous farm-management research and the Bureau's personnel available for this type of investigation, in cooperation with the personnel of the Planning Division of the Agricultural Adjustment Administration, it was possible to conduct the study on a Nation-wide scale. At the time of the writing of this report, the results are being summarized separately in the main agricultural regions of the country, and the results thus far brought together indicate that the adjustments shown to be desirable in the light of good farm management and soil conservation are, to a substantial degree, in general harmony with the adjustments sought by the agricultural-adjustment program, except that the adjustments in the changes indicated as desirable by this study would not be brought about in the same degree in all sections, but would provide for adjustments more nearly in accordance with the regional differences in agriculture.

This body of data, when supplemented by the results of further research, it is hoped, will afford a basis for a relatively permanent and more satisfactory agricultural-adjustment program.

Thus the research in farm management carried on by the Bureau in cooperation with the experiment stations and independent studies conducted by the stations in this field and in regard to the technological aspects of agriculture, have been focused for the first time on a national scale upon the problem of agricultural adjustment in line with the national policy embodied in the Agricultural Adjustment Act. This is an example of the way in which present and past research may be coordinated with and used as a basis for an administrative program to effectuate a national policy embodied in an act of Congress.

#### RESEARCH IN TYPES OF FARMING

The line of research in types of farming as it has developed and gone forward has both descriptive and analytical phases. Its objectives are (1) to depict the agriculture of the United States as it varies from region to region and area to area throughout the country and to characterize the farming thus geographically differentiated in terms of selection of enterprise, size of operating units, sources of income, and methods of operation; and (2) to analyze the relations between the farming thus described and the forces and conditions that have shaped it. These conditions consist of the peculiarities of soil, surface, climate, and other physical conditions, on the one hand, and the economic forces that tend to influence agriculture primarily through prices of products and the prices of cost goods and services, on the other.

At the end of the fiscal year such projects had been completed in the following 17 States: Washington, Idaho, Colorado, Wisconsin, North Dakota, South Dakota, Nebraska, Kansas, Missouri, Oklahoma, Texas, Minnesota, Michigan, Indiana, Illinois, Pennsylvania, and Kentucky. Projects in operation in 1935 but not completed included those in Montana, Utah, Wyoming, Oregon, California, West Virginia, Tennessee, Mississippi, and Iowa. Thus at the end of the fiscal year such type-of-farming projects had been completed or were in progress in 26 States.

Results of these type-of-farming studies have already proved of value through the use that has been made of them by workers in the land-use planning project, in studies on farm reorganization, in the regional agricultural-adjustment project now in progress, and as a basis for orientating other research projects and extension work.

#### A DETAILED STUDY OF WHEAT FARMING

A study of organization and practice in all of the areas of the wheat region from the Pacific Northwest eastward to North Dakota and southward through the specialized spring and winter wheat belts to Texas and New Mexico was undertaken in the fall of 1933. Field work was completed a year ago, and work on tabulation and analysis of the data has been in progress during this fiscal year. Sample records were taken on from 40 to 60 farms in each of 65 areas. It is hoped that the study will show the nature of farm organization and production methods in the specialized wheat areas and ascertain what are normal yields and the frequency of different rates of yields in order to determine the basis of successful wheat production, the



chances for success or failure, and the need for readjustment area by area throughout the entire Wheat Belt.

The cost of using tractors, motor trucks, and combined harvester-threshers is another phase of the study of the economics of wheat farming in the Great Plains and northwest wheat country.

The maintenance cost of such machines is largely cash outlay, including depreciation. The system of farm operation provides little room for any immediate displacement of this cash outlay with animal power, which to a large extent could be provided by the farmer's own producing unit. Obviously such a change would mean a greater cash outlay for hired labor and less wheat to sell or more feed to buy, with a given acreage.

The development of machinery for the wheat country has been one of the strong forces in the expansion in wheat production into areas of irregular and low average yields. The mechanized system of production developed has merit in areas of relatively large-scale operation in years of good production and good prices for wheat, but the heavy cash outlays incident to such a system make it difficult for highly mechanized farms to survive periods of unusually low yields or low wheat prices.

In 1933 farmers reported that the original cost of a 16-foot combine, a 23-horsepower track-laying type of tractor, and a 1½-ton motor truck, was about \$6,300. The annual cost of maintaining these three machines including repairs, depreciation, fuel, oil, taxes, and interest, was about \$1,700. In 1934 about 3 bushels of wheat per acre was required to pay the operating costs of these three machines in the Northwest, but in 1932, when wheat prices were low, about 5.5 bushels was required.

#### **COST OF PRODUCING CORN, WHEAT, OATS, MILK, AND COTTON**

The annual mailed questionnaire inquiry into the cost of producing corn, wheat, oats, and cotton was carried on again this year. The 1934 costs are now being computed.

This year the Bureau cooperated with the New Jersey Agricultural Experiment Station in a study of the cost of producing milk from 176 dairy herds containing 4,089 milk cows in 8 cow-testing areas in New Jersey. A summary of the results was published.

#### **LOCALIZED STUDIES IN FARM MANAGEMENT**

A study of farm organization and practice in the High Plains cotton area of Texas, located in Lubbock County, is being made in cooperation with the Texas Agricultural Experiment Station. It aims to ascertain the economic and technical factors involved in the production of cotton under the semiarid conditions characteristic of the portion of the Cotton Belt in which notable expansion in cotton production took place during the decade 1920-29.

A somewhat similar study of plantation organization in the Delta area of Mississippi is under way. Three years of field work have now been completed.

At the request of the Kansas Agricultural Experiment Station the Bureau is collaborating with that station in a special study of conditions in southwest Kansas, where damage to land from soil blowing was most acute, to determine among other things, whether a submarginal-land-buying project should be established. This survey of agricultural conditions in that part of southwestern Kansas lying south of the Cimarron River shows a need for—(1) Some means of reestablishing permanent grass cover on the light, sandy, cultivated soils of the area; (2) a program to rehabilitate a number of the better farms in the area by giving immediate financial assistance and aiding adjustment in size of the farm unit and system of farming, and (3) a program under which farmers on land of low productivity, or on too small an acreage may be given an opportunity to reestablish themselves in other areas.

#### **FARM TAXES**

The Bureau's index of farm real-estate taxes per acre has been carried through 1933 and 1934. The trend is still downward from the peak of 241 in 1929 (1913=100), but the 1934 levy still averaged 151 percent of the 1913 level.

The decrease has become much less rapid, however, several State averages showing increases from 1933 to 1934. As related to real-estate values an average decrease did not begin until 1932.

Extensive tabulations of rural tax-delinquency data were made with Federal Emergency Relief Administration funds. These data represented about 600 counties of the 2,300 counties for which data were obtained with Civil Works Administration funds during the preceding year. A preliminary summary was issued covering 1,536 counties (out of 3,071 in the country), and detailed State reports are now being issued as rapidly as they can be prepared; 20 were published during the year.

Public interest in the subject has been keen. The agricultural experiment stations of all 48 States cooperated in the field work on the project, and the study has had a wide influence in stimulating and directing thought on the problem. Continuation of work on some phase of the subject is reported from 34 States; publications have been issued or are in process of being issued in 22 States; 10 States report the use of the information by State legislatures or legislative committees; 15 report its use by State officers, and 13 by local officers; in 30 States it has been used by land policy boards or similar organizations; 13 States have mapped delinquent properties; and 9 report the use of the material in classes or other regular college work.

Realization of the benefits of this project are illustrated by the head of a State college department who judges the project to be "among the most valuable accomplishments of the C. W. A." He continues:

Letters from county officials and interested citizens tell us that the study in this State could be justified on the basis of increased collection of taxes alone. \* \* \* Figures which were released in this State have been quoted freely in the State legislature and there is a possibility that they may result in the appointment of assessors on a full time and scientific basis.

With rising taxes and declining land values, farm real-estate tax delinquency rose rapidly after 1928. Present estimates indicate a 200-percent increase both in area and in amount of delinquency between 1928 and 1932. In 1,536 counties 200,000,000 acres were reported delinquent on the 1932 levies. A decreasing number of tax liens have been purchased by individuals, the remainder of necessity being held by taxing jurisdictions.

Much of the delinquency is short-term but chronic. Owners repeatedly fall into arrears, and pay their taxes when a few months or a year or two over-due. In this respect necessary delinquency should be distinguished from "wilful" or "voluntary" or "accidental" delinquency. Relatively few cases of actual dispossession or alienation of title are shown by the tabulation. By 1932, owing largely to increased farm incomes, the crest of new delinquencies probably was reached. This appears to be true despite the probable increase in amount of delinquency by accumulation on properties already in arrears.

#### BANK LOANS IN AGRICULTURE

The wide-spread difficulties of country banks since 1920 have greatly curtailed the credit available to farmers from this source. The number of banks in the United States decreased from 30,560 in 1921 to 15,835 in 1934, a large proportion of the decrease occurring in agricultural areas. To measure the decline in bank loans to farmers and the present amount of bank credit extended to farmers, a survey was conducted as of the end of 1934. With the cooperation of the Federal Deposit Insurance Corporation, the Comptroller of the Currency, and the Federal Reserve Board, schedules were enclosed with the year-end call for report of condition.

#### NET DEMAND DEPOSITS IN AGRICULTURAL AREAS

The Bureau's indexes of net demand deposits of country banks has had increasing usefulness and is supplied monthly to the Treasury Department, Farm Credit Administration, and the Agricultural Adjustment Administration. The last-named organization has frequently presented the data as legal evidence, and two new indexes, covering two wheat-growing areas, have been prepared for this purpose.

Tabulation of returns from 99 percent of all commercial banks showed \$1,306,000,000 outstanding bank loans to farmers, a reduction of \$4,000,000,000 from the estimated total for December 31, 1920. Of the 1934 amount, 38 percent was secured by real estate; 20 percent by livestock, crops, or both; 11 percent by warehouse receipts, etc.; 5 percent by miscellaneous means; and 26 percent unsecured.



**FARM PROPERTIES ACQUIRED THROUGH FORECLOSURES**

As a result of reduced farm income and the consequent rapid increase in foreclosures lending agencies are now substantial holders of farm properties. Information from banks, life-insurance companies, and land banks has made possible the following estimates of the market value of the farm real estate held by corporations as compared with the market value of that they held in 1930: 174 percent in 1932 and 262 percent in 1933. Substantial additions have been made since 1933. Refinement of the figures is desirable, and tabulations are being made showing distribution by counties and by lending agencies at the end of 1934. Further data are being obtained and similarly classified, as an aid in preparing debt estimates.

A report of considerable usefulness has been issued summarizing and analyzing data issued annually by the Bureau under the title "Farmer Bankruptcies, 1894-1934."

**COUNTRY-BANK POLICY**

A study of country-bank policy as related to the availability of credit to farmers was made in Arkansas in cooperation with the State agricultural experiment station, at the request of the State bankers association. The following two reports have been published as bulletins of the Arkansas Experiment Station: Bulletin 298, General Indicators of the Condition of Arkansas Banks, and Bulletin 315, Bank Failures in Arkansas. These publications have aroused considerable interest in other States, and cooperative field work on similar studies is now under way in Wisconsin and Utah.

**PRODUCTION-CREDIT LOAN POLICIES**

A study has been made of problems met by the Federal Intermediate Credit Bank of St. Louis in rediscounting paper for agricultural-credit corporations and livestock-loan companies. Analyses of 500 cotton-production loans and 500 livestock loans were made, and the policies followed in making available this type of credit were evaluated. A preliminary report giving an experimental analysis of factors affecting the collectibility of cotton-production loans was issued.

**SEED LOAN BORROWINGS**

Seed-loan data regularly compiled show that these loans continue to be of importance from the standpoint of number of borrowers. Despite 2 years of operation of the new production-credit system, the number of seed loans has been large in some areas where farm income has shown marked recovery, particularly in the Southern States. For example, in Virginia, North Carolina, South Carolina, and Georgia there were 117,016 seed-loan borrowers in 1934 and 90,193 in 1935. This continued borrowing has an important bearing upon the development of agricultural-rehabilitation policies, and the experience gained in extending seed-loan credit offers a wealth of pertinent data. A preliminary analysis of seed-loan financing since 1921, with particular reference to four southeastern cotton States, is now being prepared.

**AGRICULTURAL INSURANCE**

Special attention was given to further improvement in insurance forms and practices of farmers' mutual fire-insurance companies, and notable progress is observed in their use. The computation of summaries of farmers' mutual company business was continued. The tabulations show remarkably good records and substantial growth for these companies.

**FACTORS AFFECTING THE PRICES OF INTERNATIONAL AGRICULTURAL COMMODITIES**

An index of world industrial production has been prepared to afford a measure of changes in world demand. This index and its component, an index of industrial production outside the United States, were used in an analysis of cotton price and cotton consumption included in the Bureau's report on the cotton situation.

### PROBLEM OF DETERMINING CURRENT FARM INCOME

In response to pressing demands, the Bureau undertook to estimate receipts from the sale of farm products monthly, by States. A fairly satisfactory basis of estimating receipts from the sale or income from farm products, monthly, within about 20 days of the close of the month, has been developed. For comparison, estimates have been extended backward, monthly, through 1929. These estimates are being widely circulated and extensively used in keeping up to date with changes in farm income in different parts of the country, and in observing factors important in determining the level of, or changes in, income from agriculture in the several States.

### COST OF TRANSPORTATION

Transportation research has included the collection of a large volume of data in regard to the effect of freight rates upon the shift in the transportation of agricultural products from railroads to trucks. Considerable attention has been given to the effects upon the movement of agricultural products and the returns to farmers of maintaining freight rates with little or no change, in the face of declining prices for farm products. Data and the results of analysis have been furnished to representatives of the Department for use in hearings before the Interstate Commerce Commission in cases involving freight rates upon specific agricultural commodities and the relations between agriculture and transportation.

### COMPLETION OF THE REPORT ON THE DIRECT MARKETING OF HOGS

The study of the direct marketing of hogs which had been carried on during the previous spring and early summer was completed and published early in 1935. Considerable work had been done on this project over a period of several years, but an expansion of the study was made necessary in late 1933 as a result of increased demands on the Department from producers and trade agencies for a complete investigation of this method of marketing. The finished work provides the most comprehensive study of the subject yet completed.

### DATA ON SHRINKAGE OF HOGS

In the research studies dealing with the direct marketing of hogs, special emphasis was given to dressing yields and shrinkage in transit of hogs purchased direct and at public markets. The ratio of dressed carcass weight to purchased live weight is one of the major factors that slaughterers must take into consideration in making their bids for hogs. Basic information on dressing yields of hogs and the amount that hogs shrink in transit is needed, therefore, by hog producers, livestock marketing agencies, and packers in arriving at fair prices for hogs bought under varying conditions.

Analyses were made of yield and shrinkage data on more than 6,000,000 hogs purchased both direct and at public markets. The data were obtained from the records of representative packers (national, regional, and local) who cooperated in furnishing the information. The results are being prepared for publication.

### STUDY OF THE PACKERS' MARGIN

To ascertain the changes in the gross margins taken by hog slaughterers over a long period of years, the monthly and yearly combined wholesale values in Chicago of all the products obtained from hogs were computed for the period 1905 to date. These values were compared with the concurrent average prices of the better grades of hogs, and the margin or spread between the hog price and the combined product value was computed. It was found that this spread widened greatly during and immediately following the World War period and that it continued relatively wide until about 1932, when it was reduced somewhat. The study also revealed that there is a marked seasonal change in the margin each year. The information developed through these price studies has been used also by the Agricultural Adjustment Administration in connection with studies and problems with which they are dealing.



## THE LOUISIANA STRAWBERRY SITUATION

After the unsatisfactory strawberry-marketing season in Louisiana in the spring of 1934, following a series of unsatisfactory seasons, the Bureau was asked to make a study of the production and marketing of this crop. The results were issued as a mimeographed report. A few of the conclusions from the study are: Returns to Louisiana strawberry growers after deducting cash expenses averaged only about \$500,000 in the 3-year period 1932-34, as compared with about \$2,000,000 in the previous 3 years. Since the average grower in the Louisiana district has only 3 or 4 acres in strawberries, the average returns in the last 3 years have not been sufficient for adequate maintenance of a family. The margin of gross profit for wholesale handlers of these berries in recent years has been small; any large increase in the price per crate to the growers is apparently dependent on higher retail prices. A greater production of vegetables and other crops for home use is desirable. The report includes detailed data on costs of production, yields, distribution, prices, and marketing methods, which will be useful in planning and making adjustments in the Louisiana strawberry industry.

## ESTIMATE OF MARKET MOVEMENT BY MOTOR TRUCK

The use of the motor truck in marketing fruits and vegetables is causing more discussion and bringing about greater changes than any other recent development in the marketing field. Handlers of carlot shipments in the markets with established places of business find it difficult to compete with truckers in handling commodities produced within a radius of 500 miles. The advent of the motor truck has introduced new problems in relation to such phases as grading, regularity of supplies, and price movements. A report is being prepared which shows approximate quantities and percentages of each of 33 fruits and vegetables moving to consuming markets by truck in each of the years 1933 and 1934.

An analysis is being made of other phases of motor-truck marketing. The report of quantities moved by motor truck is based on all available sources of information within the Bureau, such as truck receipts at certain cities, market-news field-station reports, and reports from supervising inspectors. State agencies familiar with this subject have been consulted. In 1934 carlot and boat shipments of fruits and vegetables in the United States exceeded 800,000 cars. Estimated motor-truck shipments amounted to slightly less than 500,000 cars, or about 38 percent of the total market movement.

Every effort is being exerted in terminal-market offices of the Bureau to get as complete information as possible on current motor-truck receipts of dairy and poultry products. Local wholesalers, jobbers, chain stores, and others who receive dairy and poultry products by motor truck supply information regarding quantities received and States in which shipments originated. During the year a special check was made on motor-truck receipts at Chicago, New York, and Boston. A similar check is now being made at other markets.

## NEW RESEARCH IN THE FIELD OF MARKETING

A new Division of Marketing Research was established in January to furnish bases for the study of both new and old problems of distribution and consumption. The high marketing costs and low prices which have obtained for many years have emphasized the need for a vigorous program of marketing research to help reduce the spreads between producer and consumer, which in many cases indicate inefficiencies in the marketing system rather than excessive profits in distribution.

Price spreads in foreign countries are frequently narrower than in the United States. Accurate and detailed facts about price spreads and reasons for them are necessary as a basis for measuring changes in marketing efficiency and for determining the extent to which costs such as wages, materials, and processing taxes are passed on to consumers or passed back to farmers.

Many present marketing facilities and methods are uneconomic and inadequate. Rapid development of motor-truck distribution, large-scale retailing, and direct marketing, as well as the recovery measures, have brought about great changes in distribution, without corresponding changes in many marketing facilities, costs, and methods. Investigations looking toward reorganization

of physical facilities of marketing are being projected as part of the general program of readjustment.

Farmers and consumers are vitally interested in these developments. If agricultural recovery is to be complete and lasting there must be better service to the consumer, reduction of waste, and increased efficiency in the marketing process, to accomplish better distribution and greater consumption, as well as to raise incomes of growers. Provisions of the recovery legislation can be used for these purposes, but a broad research program is needed to lay the basis for policies that will promote the best interests of farmers and not be a burden to the consuming public. Several lines of work carried on by this new division can be reported.

#### **ECONOMIC EFFECTS OF A. A. A. MARKETING AGREEMENTS AND PROCESSING TAXES**

The marketing-agreement section of the Agricultural Adjustment Act makes possible a new kind of cooperation among farmers, dealers, and processors for the purpose of improving marketing conditions and raising the incomes of certain groups of farmers, partly through regulating the flow of farm products to the market, regulating the qualities and grades sold, standardizing charges for processing and handling, and deciding on minimum prices paid to the farmers.

Realizing the importance of careful research as a basis for such a long-time program, the Agricultural Adjustment Administration requested that this Division undertake a series of studies of the problems encountered in the administration of marketing agreements. Intensive studies have been made of the agreements covering California cling peaches and California asparagus, and northwestern fruit, walnuts, and citrus fruit, and some attention has been given to most of the other agreements.

Studies of the effects of processing taxes have been made, particularly in relation to wheat, cotton, and hogs. Briefly the findings are that processors in general have not absorbed the taxes, but that they have been passed on to the consumer or have tended to lower prices to farmers below what these prices would be if some means other than processing taxes were available for financing the program. If the effects of the taxes are considered, along with benefit payments to farmers and with price increases due to the control of production, it is evident that the income of wheat producers, cotton producers, and hog producers has been raised.

#### **PRICE SPREAD BETWEEN PRODUCERS AND CONSUMERS**

The importance of the margin between prices received by farmers and prices paid by consumers for food and other farm products has increased since 1934 because of increased wages and increased costs of materials used in the transportation, processing, and marketing of farm products, because of processing taxes which have added to processors' costs, and because of changes in marketing methods (including the adoption of marketing agreements in several industries) which have affected costs and charges for the services needed in getting foods and other agricultural products from the farm to the consumer.

A series of studies is now under way analyzing the relationship between the prices received by farmers and the prices paid by consumers for about 50 agricultural products. A report has been issued summarizing from 1910 to date the month-to-month changes in the total price spread between the farm and the city retail store for the following 10 foods: Beef, pork, hens, eggs, milk, butter, cheese, potatoes, flour, and bread.

#### **RESEARCH IN THE FIELD OF LAND ECONOMICS**

During the year, steps were taken by the Federal Government to effectuate a definite, unified land policy. The Agricultural Adjustment Administration established in its Division of Program Planning a Land Policy Section, the general function of which is to develop and carry out, as a phase of the Administration's agricultural adjustment program, a coordinated national program for the better use of our land resources. The Public Works Administration allotted to the Federal Emergency Relief Administration an initial sum of \$25,000,000 for the purchase of submarginal lands. The President requested the preparation, by the newly created National Resources Board, of a comprehensive



national report, with recommendations for appropriate action, on land utilization and land policy. This Bureau contributed substantially to the preparation of this report.

Studies in the changes in land utilization, both intensive and extensive, were heavily drawn on in connection with the report of the National Resources Board, and certain of the sections of that report embody the findings of years of intensive investigation by the Bureau. The general survey of "distress areas" in the utilization of land was incorporated in the section of the report that deals with maladjustments in land use and proposed lines of action.

This study showed that the annual cash income of farmers in the areas from which it is desirable to encourage withdrawal of arable farming was less than \$250 and for many was less than \$100 even during the relatively prosperous conditions existing in 1929. The living available on land yielding such low incomes is wholly inadequate. Many of the families are undernourished. Educational and cultural opportunities are meager, and governmental services are at a minimum, or, if at all adequate, are provided at high unit cost to the local community and the general public. It also indicated that during the depression probably 30 percent of the farmers in such areas were on relief.

The total area which it is estimated should be withdrawn from farming is 75,000,000 acres, of which 20,000,000 acres is crop land and 35,000,000 acres pasture land.

#### LAND PROBLEMS IN THE GEORGIA PIEDMONT

In its investigation of land-use problems, the Bureau selected as a major region for study the old-plantation piedmont cotton belt of Georgia. The general objective has been to ascertain facts on which may be developed public and private programs of action to bring about the profitable utilization of land and to improve the economic and social conditions of the rural population. On the basis of the facts developed in the study, the Federal Government has initiated a submarginal land-purchase project in the State.

Generally speaking, the decline in agricultural development started in the old-plantation piedmont cotton belt and progressed northward and southward. The decline, in large part, is the result of a detrimental land-use cycle practiced mainly by cotton farmers. Allowing land to revert to forest or other vegetative cover is merely one step in that cycle. Land was cultivated until erosion gullied the fields or washed the surface away. Forest or other natural vegetative cover tended to check erosion and gradually build a new topsoil.

Approximately 85 percent of the land in the 35 counties (covering about 25,000 square miles), representing the old-plantation piedmont cotton belt, has been used for cultivated crops one or more times in the course of years. At present only 24 percent of that area is being used for cultivated crops. The system of farming practiced, which does not include adequate protection against erosion or leave the steeper slopes permanently in woodland, has not changed.

#### IMPROVEMENT IN THE FARM REAL-ESTATE SITUATION

The ninth annual report on the farm real-estate situation was issued during the year. The report showed that the year ended in March 1934 brought the first general upturn in farm real-estate values in more than a decade, a reduced frequency of distress sales, increased frequency of voluntary transfers, expansion of the farm-mortgage credit facilities of the Farm Credit Administration, and the compromising, refinancing, or other adjustment of a large amount of mortgage indebtedness. These developments were traced in large part to the upturn in farm prices and in income from farm production, and to the expanded activity of the Farm Credit Administration, together with a growing recognition on the part of mortgage holders generally that the interests of both creditors and debtors would be served best by reasonable compromising of unmanageable debt.

The report stated that for the country as a whole for the year ended March 1934 farm real-estate values increased from 73 to 76 percent of those for the 1912-14 period taken as representing pre-war values, that the frequency of voluntary sales increased from 16.8 to 17.8 farms per 1,000 of all farms, that frequency of forced sales and related defaults as a result of delinquency on mortgage debt declined from 38.8 to 28.0 farms per 1,000 of all farms, and that similar transfers as a result of delinquency on taxes decreased from 15.3 to 11.1 farms per 1,000 of all farms.

## FARM POPULATION FACTS AND ESTIMATES

The usual estimate of change in the number of persons living on farms and migrations to and from farm and town was made as of January 1, 1935, applying to the calendar year 1934. A new feature in the report included data on farm acreage and the number of occupied dwellings for the farms covered by the schedules. These data have been tabulated by counties and will be compared with 1935 census data on the same items as evidences of the reliability of the sample.

Completion of the study, begun several years ago, of the interstate migrations of the native white population as revealed by census data from 1870 to 1930 made it possible to prepare and issue a series of chart maps indicating a significant part of the movement from State to State. These constitute valuable base material for more intensive studies.

## LOCAL GOVERNMENT UNDER STUDY

Interest in local government and in the possibilities of making it less expensive and more efficient grows daily. In response, the Bureau has aided several States in the study of local governmental problems.

Farm taxation and local government in Noble and Putnam Counties, Ohio, were studied on the invitation of the Governor's Commission on the Reorganization of Local Government. Other research agencies are making studies of several Ohio cities and urban counties. As a recent State constitutional amendment permitting alternative forms of local government was adopted last year, it is expected that all of these studies will assist in the working out of effective forms of reorganization.

Results of studies of farm taxation and local government in Crittenden and Livingston Counties, Ky., concluded late last year, were published this year and are already bringing encouraging results. In addition to the major conclusions, some of which recognized the impracticability of attempting certain plans, concrete suggestions were made for the purpose of balancing the budget and effecting needed changes in organization and functioning on a permanent long-time program, as well as several suggestions of an emergency character needed to break the existing circle of mounting deficits and debt-service costs. A number of these suggestions have since been incorporated in State laws, and recent reports from both counties indicate substantial progress toward financial stability and greater efficiency in the operation of local government.

## ECONOMIC LIBRARY AIDS RESEARCH

That the work of the Bureau library is closely correlated with the activities of the Bureau is clearly indicated in the extensive bibliographic material on subjects of pressing importance which the library makes available in both printed and mimeographed form. Other activities of the library include immediate reference work on a wide variety of economic questions, the indexing of pending and enacted economic Federal legislation, the circulation of much current economic material, and the preparation of the monthly mimeographed publication entitled "Agricultural Economics Literature."

During the year the bibliography, *Land Settlement, With Particular Reference to Small Holdings and Subsistence Homesteads*, was printed. It has been of great service to those who are working on land problems in the United States Department of Agriculture and elsewhere. This bibliography was submitted in competition for the Oberly Memorial Prize and won the award. The prize is offered every 2 years by the American Library Association for the best bibliography in the field of agriculture and related sciences. This was the fourth time this national award has been won by members of the staff of the library of the Bureau of Agricultural Economics.

The titles of a few of the more significant bibliographies or lists of references compiled during the year are as follows:

Agricultural Credit in Foreign Countries; Frazier-Lenike Farm-Mortgage Act; Supplement to Foreign Competition with American Cotton; Cotton in China; The Southern Share Cropper; Some Notes on Granaries and Storehouses in the Past; Social Insurance in the United States and Foreign Countries; Measures of Major Importance enacted by the 73d Congress March 9 to June 16, 1933, and January 3 to June 18, 1934; The Marketing of Agricultural Products; A Selected list of hearings of the 73d Congress on marketing and related



subjects: Land Policy—Cuba; Land Settlement in Brazil; Wheat Policies of Foreign Countries; References to Tax Studies in the States; Export Bounties on Butter and Cheese Granted by Foreign Governments since 1927; Selected References on the Marketing of Vegetables; Commercial Canning of Fruits and Vegetables, June 1929 to June 1934; and Statistics of the Consumption of Milk in the United States.

There has been a steadily growing use of the library by the Agricultural Adjustment Administration, by other economic agencies within the Department, and by most of the newer agencies of the Government.

#### PUBLICATIONS AND INFORMATION EXTENSION

The printed publications issued during the year were somewhat fewer in number than in recent years, but the total page content was slightly increased. Several unusual publications were among those issued. Those that should be mentioned for their size and comprehensiveness are Miscellaneous Publication 205, Economic and Social Problems and Conditions of the Southern Appalachians, Miscellaneous Publication 222, The Direct Marketing of Hogs, and Technical Bulletin 466, Agriculture in Southern Africa. Two manuscripts which were prepared in this Bureau were issued as Congressional Documents, House Document 405, Cotton Classing and Market News Service for Farmers, and House Document 406, The Farmers' Tax Problem.

In the current and emergency work of the Bureau, mimeographed and multi-graphed publications were used in greater numbers and in larger editions than ever before. Much of the current statistics and analyses of economic problems was issued in this form. The total number of various reports and titles issued currently by the Bureau now mounts into the thousands. The principle of distribution has been to prepare a special report or mimeographed release whenever the requests for the information amount to 100 or more, since this form of distribution saves expense by reducing correspondence and makes it possible for technical workers and others to list and identify the various sources of Bureau information.

Large editions of many publications were distributed in cooperation with the Extension Service and the field organization of the Agricultural Adjustment Administration. In general, the use of economic information by all agricultural educational agencies has shown steady growth.











## REPORT OF THE CHIEF OF THE BUREAU OF AGRICULTURAL ENGINEERING, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF AGRICULTURAL ENGINEERING,

Washington, D. C., September 10, 1935.

HON. HENRY A. WALLACE,

*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith the report of the Bureau of Agricultural Engineering for the fiscal year ended June 30, 1935.

Sincerely yours,

S. H. McCrory, *Chief.*

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Engineering in agriculture seeks to utilize the materials and forces of nature to lighten the labor and reduce the cost of producing farm products, and to increase the satisfaction of farm living. Application of engineering in agriculture begins with preparation of the land for crops by clearing of trees, brush, and stones, by draining of wet areas, by obtaining water for irrigation, or by a combination of such operations. It continues in the cultivation, fertilizing, harvesting, and storage of crops, in the sheltering and handling of livestock, in combating pests, and in the farm processing of the products of fields and flocks, as well as in the housing of the farm family. It involves the development of methods and of equipment for effectively and economically performing the operations that contribute to the profit or the enjoyment of living on the farm.

The Bureau of Agricultural Engineering is engaged primarily in research along the lines of farm irrigation, farm drainage, farm-land improvement, farm machinery, farm buildings, and cotton ginning. Studies are made to define the immediate objective of each operation, and then to develop a practice or to adapt or design an implement that will achieve that objective. A large part of the research work is carried on in cooperation with other bureaus of the Department and with State agricultural experiment stations. In response to many requests from Government organizations engaged in emergency relief activities, many specialists of the Bureau during the past year have rendered consultant or field engineering services to those agencies, for periods ranging from a few weeks to several months.

### IRRIGATION INVESTIGATIONS

The value of an adequate water supply for the production of crops has never been more strikingly emphasized than during the past year, when agriculture in many parts of the country was a complete failure because of drought. Not all of the area normally irrigated entirely escaped loss of crops, but the losses in the irrigated region were minor in comparison to those in the areas that lost not only the crops but also farm stock and, by reason of dust storms, in some cases even the fertile topsoil itself. Because of this experience, provision for an assured water supply and a system of irrigation will be wanted for larger areas of agricultural land. It is fortunate that the farmers in such areas will have available the data that have been developed by irrigation research.

At the present time the stimulation of interest in irrigation agriculture is evident in the migration that is in progress from semiarid areas to localities where irrigation is the regular practice. While there has been no recent expansion of the irrigated area, there has been a concentration of farming population on the better lands within that area, resulting in abandonment of

submarginal lands in the irrigated sections just as in areas dependent on natural precipitation for necessary soil moisture. The prospect of complete utilization of the fertile lands in the irrigated region is brighter now than ever before.

Studies of many problems resulting from the occurrence of the unprecedented drought in 1934 and arising in connection with other relief activities of the Government have involved the personnel of the Division of Irrigation to a considerable extent, and consequently have interrupted progress on much of the regular research work. The emergency assignments were not without compensations, however, from the Bureau standpoint, for they have brought to light some modern problems in irrigation of rice from wells in Arkansas; have developed opportunity, in connection with a small irrigation district in California, for something of a specimen study of the engineering and fiscal difficulties into which many important agricultural enterprises have fallen; have suggested study concerning changes in irrigation practices that might be considerably effective toward controlling, for example, certain alfalfa diseases; and have emphasized the need for further investigation as to methods of constructing small dams and farm reservoirs for checking floods and conserving water, especially in the Great Plains.

#### UTILIZATION OF WATER

Until somewhat recently the major objective of research work in irrigation has been to obtain the maximum crop yield per unit of water supply, commonly called the efficiency of irrigation. During the past few years, however, economic changes such as increase of production and contraction of markets have made the matter of low cost of crop production more important. The result is to place the emphasis upon maximum crop yields per unit of land area rather than per unit of irrigation water, in order to reduce the costs of cultivation and the capital investment. The effect may be to concentrate use of water on the better lands and force the poorer lands out of production, and consequently increase the value of the better lands. In studies prosecuted during the past fiscal year, particular emphasis has been placed on the use of less land for irrigation, the lowering of cultural costs, most effective use of irrigation water, and production of better and consequently more valuable crops.

In the cooperative studies with pears in the Medford, Oreg., district, the past year's data confirm the earlier conclusions and show beyond question that maximum production is to be obtained by keeping the soil very moist. Efforts are being concentrated on methods of procuring better penetration of irrigation water into the tight soil. If better penetration can be secured, probably the number of irrigations can be decreased which will reduce the cost and the management difficulties.

Work on the rate of infiltration of irrigation water offers hope that a method may be devised by which proper length of irrigation borders and quantity of irrigation head can be fairly estimated in advance of actual irrigation. The advantage of such a method is illustrated by our cooperative investigations on the Umatilla Field Station. When the new station was being planned, it was estimated that an irrigation head of 5 second-feet would be required on strip borders about 50 feet wide and 300 feet long on the loamy sand. It has been found that a head of 5 second-feet is much too large for borders of this size. By means of data obtained from infiltration tests and of formulas worked out in cooperation with Oregon State Agricultural College, it was determined that strips 800 feet long on this soil could be successfully irrigated with a head of 3 second-feet. The saving in cost of field ditches and in labor which would result from use of the longer strips is obvious.

The studies in irrigation of citrus crops in southern California, particularly in the Pomona section, were continued. Special attention was given to the use of a limited water supply for irrigating citrus orchards and the factors contributing to higher efficiencies. We are convinced now that the original preparation of the land will have a considerable effect on the efficiency of irrigation. Soil type, topography, distribution systems, and manner of planting are all important in determining what measure of success the irrigator will have in distributing water evenly over the land. For surface irrigation it is well to have uniformly graded land surfaces with distributing pipe lines so laid out that furrows are relatively short. Flat land, especially sandy



soils, may be basined or irrigated with cross-blocked furrows, but steep slopes must be contoured or terraced to prevent washing. The development of low-head sprinkler irrigation systems, and the use of portable slip-joint pipe have lowered the cost of overhead irrigation so that this method now has a wider application.

The straight-furrow method of irrigation, however, is still the one most widely used in orchards. Therefore considerable work has been directed toward improving practices under this method. Table 1, showing measured rates of absorption of water, illustrates the variation that may be encountered within the same orchard. The average rate for the furrows next to the trees was just three times that for the furrows farther away. Recognizing that such variations occur, many farmers are now testing the penetration of water at the end of each furrow before shutting off the flow.

In citrus orchards the greatest concentration of feeder roots is near the ground surface, where they may be considerably injured by common cultivation practices. Control of weeds is important, however, because they use water and plant food that are supplied for the trees. To control the weeds with a minimum of injury to the tree roots, Bureau engineers have developed a method of cultivation that establishes permanent broad, shallow furrows with relatively flat side slopes. Cultivating sweeps are designed to travel through the furrows and slice off the weeds without breaking down the ridges between the furrows. In this way weed control is accomplished with a minimum of soil disturbance, which reduces cultivation cost, and increases irrigation efficiency.

TABLE 1.—*Rates of absorption of water from irrigation furrows 360 feet long in a navel-orange orchard*

Tree row no.	Rate of absorption, in cubic feet per second				
	Furrow 1	Furrow 2	Furrow 3	Furrow 4	Furrow 5
3.....	0.0080	0.0015	0.0017	0.0012	0.0045
7.....	.0025	.0013	.0015	.0020	.0050
17.....	.0040	.0007	.0015	.0025	.0073
27.....	.0032	.0017	.0015	.0010	.0020
29.....	.0060	.0020	.0017	.0007	.0028
Average.....	.0047	.0014	.0016	.0015	.0043

NOTE.—Furrows 1 and 5 were next to adjacent tree rows, and furrows 2, 3, and 4 were between furrows 1 and 5, in each tree-row space.

Studies of use of water by general crops are in progress in cooperation with the Division of Western Irrigation Agriculture, Bureau of Plant Industry, at Bard in southeastern California, and at Scottsbluff, Nebr. At Bard, experiments are being run with cotton, mature alfalfa, young alfalfa, barley, wheat, grain sorghum, corn, and citrus-fruit trees. This is the third year of a 5-year program to determine the quantities of water required by different crops, the best methods of application, and the proper intervals between irrigations. The use of water varied with the kind of crop grown, but no definite conclusions can yet be drawn.

The routine work for the 1934 season at the Scottsbluff station was materially disturbed by the unusual drought conditions. At the beginning of the season it was apparent that there would be a shortage of irrigation water. With the supply allotted, the acreages of the various crops were reduced materially below normal, and it was determined that farmers in this section have been using more water than enough for irrigating their crops. Data collected during 1932 to 1934, inclusive, indicate that the roots of the usual farm crops are contained within about the top 4 feet of soil, and from 50 to 60 percent in the surface foot. Except for alfalfa, very little root activity is noted below the 4-foot depth. During these three seasons potatoes used on an average some 14 inches of water per season. With a limited water supply and depressed prices paid for farm crops, it seems very important that we should have more complete knowledge of the amounts of water required by the different crops and the times to apply the water so as to realize more efficient crop production.

The 3-year study of use of water by citrus trees in the Salt River Valley, in cooperation with the Arizona Agricultural Experiment Station, was completed in 1934. It developed the conclusions that during October to March, inclusive, citrus trees use only 50 percent of their annual water consumption; that in citrus groves the interval between wettings may be four times as long during the winter months as during the summer months; that in most orchards 67 percent of the total water consumed is taken from the upper 2 feet of soil, and the balance from the third and fourth feet, which suggests alternate light and medium irrigations; and that grapefruit trees use 20 percent more water than Washington navel orange trees. Water requirements of cotton will be studied in Arizona beginning next spring.

Surveys of use of irrigation water from Utah Lake and Jordan River in Utah were undertaken in cooperation with the State agricultural experiment station and the State engineer. Rights to the use of the water are not clearly and completely defined, some rights having been fixed by court decrees, some perfected under supervision of the State engineer, and some depending solely on long use of water by the present users and their predecessors. The State engineer is required by law to distribute the available water to the users, but for lack of data that would provide a reliable basis for making distribution to the various claimants he is confronted with an extremely difficult problem. The purpose of the investigation is to develop the irrigation data required.

#### UNDERGROUND STORAGE OF WATER

The past several years of subnormal precipitation have stimulated a renewed and somewhat increased interest in the storage of water in both surface and underground reservoirs, which emphasizes the importance of the studies in water spreading for underground storage.

While the past winter produced abnormal precipitation throughout California and particularly in the southern part, the storms were so timed and of such duration as to result in meager run-off in the waterspreading area. The rain falling on the valley floor and the snow and rain falling on the higher watershed percolated naturally into the soil and eventually to underground storage. There was some spreading on Lytle Creek and on the Cucamonga and San Antonio cones, but in all three cases there was less than the amount ordinarily spread during a season of such generous precipitation.

All of the spreading grounds were enlarged, and were improved for research work by the installation of additional measuring flumes, waterstage recorders, and ground-water observation wells with funds made available by Federal and State relief agencies. For the first time in the history of this method of water conservation, therefore, the quantity of water at any instant flowing to any unit of the spreading grounds can be determined and the total amount stored for any storm or for the season can be calculated.

The research work has been carried on while these construction units were being placed. The water supply being under control and adequate for operating experimental plots for long periods, the Azusa plots continued to be the most valuable and interesting. The spreading season on these plots this year covered 146 days, nearly a month longer than in any previous season. As in the past, data from these plots continue to show that highest rates of percolation are obtained on areas with native vegetation undisturbed. A mixture of about half oats and half barley seed was sown on plot no. 3, in the past operated as a basined plot and kept denuded of vegetation. The average rate of percolation for the season was 4.06 acre-feet per acre per day, with a maximum of 5.1 and a minimum of 2.01 acre-feet per acre per day. The corresponding figures for plot no. 1 with undisturbed vegetation were 6.7, 8.93, and 4.34 acre-feet per acre per day. A manuscript presenting the data developed to date on water spreading is in course of preparation.

#### PUMPING FOR IRRIGATION

In those areas in which it was possible to get good irrigation wells during the drought of 1934, large numbers of new wells were put down to obtain supplemental water supplies. Because of the necessity for haste and the lack of knowledge, many of the irrigation wells were poorly constructed. As a result, they are not giving as satisfactory service and are not supplying water as cheaply as they should. In step with the increase in the number of pumping plants, bureau engineers have been studying the many factors contributing to an efficient pumping installation, including comparisons of well-drilling methods, efficiencies of pumps and power plants, and operation costs of motive power.



### DESIGN AND INVENTION OF APPARATUS

A study of the efficiency of different types of grating vanes for the grating type of sand trap was made at the Bellvue hydraulic laboratory of the Colorado Agricultural Experiment Station. These and prior results at the Bellvue station, as well as a limited number of tests at the silt laboratory in the Imperial Valley in California, show that the gratings catch not only the bed load but also a fair proportion of the fine material held in suspension.

On the North Poudre Irrigation Co.'s distribution system there have been completed, for the purpose of study and comparison, a grating-type trap and a vortex-tube trap having three tubes. There the wood-slat grating has been obstructed by Russian thistles matting over it, but this condition can be corrected. A design of a large combined vortex-tube and grating-type sand trap for removing silt from the All-American Canal has been prepared.

### SILT IN TEXAS STREAMS

It is well known that many streams in the Southwest carry considerable quantities of silt, which will enter any reservoir constructed on these streams and eventually practically fill the storage space above the dam. Before any storage-reservoir project is built, those who are to supply the funds for construction must be convinced that the reservoir will not become filled with silt so quickly as to make the project economically unsound. To obtain dependable data on the quantities of silt carried by southwestern streams, which vary widely from year to year, long-time records are being obtained on representative Texas streams in cooperation with the Texas Board of Water Engineers. The work was begun in 1924.

In 1935 approximately 5,000 water samples were taken at 7 sampling stations on 5 rivers, and the percentages of silt determined. The two sampling stations on the Rio Grande are in cooperation also with the International Boundary Commission. A silt survey was made of Lake Brownwood in Brown County, Tex., which showed that since the lake had been put into use in 1932 the accumulation of silt has been approximately 0.14 acre-foot per square mile of watershed per year. Ten-year records on Brazos River indicate that the silt carried by the river each year in Fort Bend County has averaged 0.6 acre-foot per square mile of contributing watershed per year during this period, and near Mineral Wells has averaged 0.5 acre-foot per square mile of contributing watershed per year.

This silt investigation has performed a service of incalculable value in overcoming erroneous beliefs as to the rapidity of silting in Southwestern reservoirs and it is now making available data with which engineers can estimate the life of proposed reservoirs in this area. Silt data are being used in calculating the life of such large projects as Buchanan Reservoir on the Colorado River of Texas, Rockland Reservoir on Neches River, and many other reservoirs proposed along Brazos River and its tributaries on the lower Rio Grande, and elsewhere throughout the State.

### EVAPORATION STUDIES

Records of evaporation from different types of pans have been continued at Baldwin Park and elsewhere in California. This study was begun about a year ago, to obtain a basis for correlating records that had been made by various agencies in the West with evaporation pans of different sizes and differently arranged with respect to land surface and air circulation. The study evidently will need to be continued for some years, as it has been found that the relation between the rates of evaporation from any two pans expressed as a simple arithmetic ratio is not constant but fluctuates with meteorological conditions.

The studies of control of algae in evaporation pans were concluded during the year. The effort was to find a control that would neither injure the galvanized surface of the pan nor affect the rate of evaporation. Copper sulphate is known to prevent growth of algae, but it affects the metal and was not used in this study. Sodium chloride, even in quantities as small as 1 percent, apparently prevents algal growth but caused rusting of the galvanized pan at the water line. Reduction in evaporation due to 1 percent of salt probably is within the limits of error in measurement. Laboratory experiments to determine if zinc chloride, boric acid, resorcinol, lithium chloride, cresol, carbolic acid, thymol, or oil of cloves would prevent growth of algae obtained negative results in nearly all cases, but only a small quantity of chemical was used, about 25 parts per million. Those chemicals that showed promise in the laboratory proved of little value in outdoor evaporation pans.

Flat black paint applied to the inside of an evaporation pan 10 inches deep had no effect on the amount of evaporation, but when applied also to the outside of the pan, evaporation increased—as was to be expected. Paint on the inside below the water surface apparently retarded algal growth, but did not prevent it entirely. Aluminum paint applied both inside and outside a pan definitely decreased the amount of evaporation.

A small amount of floating algae appears to have little effect on rate of evaporation. With the water surface about 30 percent covered with algae, reduction in evaporation amounted to about 3 percent. When the cover was increased to approximately 70 percent, reduction in evaporation increased to about 7 percent.

#### IRRIGATION IN THE HUMID REGION

For most crops in the Central and Eastern States, provision for irrigation when needed is in the nature of insurance against drought damage to crops of high cost and value per acre, such as fruits and green vegetables. In the humid region an irrigation system is operated rather infrequently, and may not be needed at all in some years. Therefore the minimum capital investment for an installation that can be depended on to furnish the needed quantity of water with such labor as is reasonably certain to be available is a more important consideration than low operating cost.

Development of the portable spray irrigation pipe mounted on wagon wheels has been sufficiently satisfactory that a mimeographed leaflet describing construction and use of the apparatus was issued during the year.

Investigation of the practicability of using vitrified sewer pipe for distribution pipe in irrigation systems has indicated that, with suitable joints, such pipe can be used for installations using pressure heads considerably higher than had previously been considered practical for this material. If the data thus far obtained are substantiated by the additional tests planned, the market for vitrified clay pipe will be enlarged and the necessary cost of irrigation installations under certain conditions will be materially reduced.

#### DRAINAGE INVESTIGATIONS

##### RAINFALL INTENSITY-FREQUENCY DATA

The compilation of detailed Weather Bureau records for the purpose of determining the intensity of maximum short-duration precipitations that might be expected to recur at different intervals was reported a year ago. This was a Civil Works project. Subsequently the engineers have applied a means of satisfactorily combining, summarizing, and generalizing the data to make the information much more easily applicable in the different sections of the country, and to permit reasonable deductions as to maximum rates of rainfall in intervals exceeding the length of the actual records.

Charts have been prepared and included in the final manuscript for publication to show, principally by means of isohyets, the maximum amounts of rainfall in periods of 5, 10, 15, and 30 minutes and of 1 and 2 hours that may be expected to recur on an average of once in 2, 5, 10, 25, 50, and 100 years, and the amounts of rainfall in 4, 8, 16, and 24 hours that may be expected once in 5, 10, 25, 50, and 100 years, throughout continental United States. No comparable compilation and analysis of rainfall data has ever been made. The information will be valuable to engineers in the design of works for soil-erosion control, farm-land drainage, culverts and bridges, flood control, and municipal drainage.

##### DRAINAGE OF SUGARCANE LANDS

The investigation to determine the effect of deep drainage upon crop yield in the sugarcane lands of southern Louisiana has been continued through the year at Houma, La. The results so far are not conclusive, but the information obtained seems to show a definite trend toward increase in tonnage of cane with increase in depth of drainage, on both the open-ditch and the tile-drain plots. The yield from an open-ditch plot on the experiment farm in 1934 was 10.6 tons per acre more than the yield from the undrained check plot. One plot in the tile-drained area produced 40.7 tons of plant cane per acre, which compared with 25.8 tons from the check plot is an increase of 14.9 tons. No conclusion can yet be drawn as to the optimum depth of drainage.



## CONTROL OF GROUND WATER IN PEAT AND MUCK SOILS

The investigations to determine the optimum depths of drainage for different crops in the peat and muck soils of Florida, and the means and cost of maintaining those depths, were continued in cooperation with the State agricultural experiment station, principally at the Everglades Experiment Station near Belle Glade. There are more than 3,400,000 acres of peat and muck soils in Florida, mostly in the Everglades section. A great part of those lands, to be suitable for cultivated crops, must be protected by levees against overflow and be drained by pumping. Maintenance of the ground-water table at a fairly uniform depth is more important in these than in the finer loam and clay soils.

One of the important considerations in the utilization of those lands is the rate and amount of subsidence or lowering of the ground surface, which results from compaction of the soil and slow oxidation of the organic matter when the soil is drained and cultivated. Lowering of the surface increases the cost of drainage by necessitating deepening of the drains and by increasing the pumping lift where the drainage water must be pumped. Where the soil is shallow over rock, subsidence may in time reduce the cultivable depth to such a degree as to greatly limit crop production and even render the land unprofitable for agriculture. The period during which the lands may be expected to be profitable is one of the factors to be considered in projecting the development of any tract of land.

The rate of subsidence of the peat and muck soils is rapid during the first few years after drainage and beginning cultivation, but decreases with time. Records on 11 profile lines that have been under observation for a number of years seem to show that the compaction of the soil takes place almost entirely in that portion above the water table. Therefore it appears that the water table should be maintained as high as is practicable without interfering with good plant growth. At Okeelanta, Fellsmere, and the Everglades Experiment Station the total subsidence in the first 20 years following drainage has been approximately 5 feet. The original depths of soil were 11.6, 7.2, and 11 feet, respectively. At the Everglades Station the average rate of subsidence during the past 8 years, on soil in continuous cultivation for the past 10 years, has been 0.12 foot per year. The rates at the other two locations have averaged somewhat higher during the same period. Collection of similar careful data, with automatic recording of water-table elevations, was begun at eight other locations in the Everglades during the past year.

Evaporation and transpiration experiments were conducted at the Everglades Experiment Station, with three tanks each 4 by 12 feet in area and 4 feet deep set in the ground with the soil inside at the same elevation as that outside. Two of the tanks and the adjacent ground were planted to sugarcane; the other tank and adjacent ground were bare. The cane was planted February 1 and cut December 12, 1934, after maturity. The water table in each tank was maintained at 1.8 feet depth by pumping water on or off as required. The rainfall was 62.2 inches. The evaporation and transpiration for the calendar year from one tank growing cane was 51.4 inches, and the yield of cane was at the rate of 46.4 tons per acre. From the other cane tank the evaporation and transpiration was 49.3 inches and the yield 33.0 tons per acre. From the tank of bare soil exposed to the sun the evaporation was 42.6 inches, while that from a United States Weather Bureau standard pan was 65.3 inches.

Pumping for drainage of 162 acres on the Everglades Experiment Station held the water table to an average depth of 1.8 feet from January to December 1934, by pumping out 8.7-foot depth of water and pumping on 0.5-foot depth. Almost all the pumping was done between June 1 and October 31. Calculations based on the records of pumping, rainfall, and evaporation indicate that seepage into the tract amounted to about 7 feet of water over the 162 acres. Drainage pumping from four areas of 2,900 to 9,500 acres of peat and muck lands growing sugarcane in southern Florida ranged from 3.1 to 7.0 feet in 1934, the differences being probably due in large part to differences in amount of seepage into the tracts. It appears that drainage pumps for cane lands in this section should have a 24-hour capacity of 1-inch depth over the area served, and that pumps for truck lands should have a capacity of 2 to 3 inches depth in 24 hours.

The mole drains 15 feet apart and 2½ feet deep are satisfactorily effective in these soils, and much less costly to install than tile drains. How long they will remain serviceable has not been determined, but some at the station are giving drainage 4 years after construction. The length of a mole drain in Everglades muck should not exceed one-eighth of a mile.

### DURABILITY OF DRAINTILE

The investigations planned to devise means of obtaining draitile resistant to soil alkalis, soil acids, and frost action, which have been carried on for several years in cooperation with the University of Minnesota and the Minnesota Department of Conservation, were not interrupted by the publication in 1933 of the results of laboratory and field tests of concrete exposed to the action of sulphate waters (Technical Bulletin 358).

The subsequent studies have devised a test routine for accurately determining the resistance of a portland cement to attack by magnesium and sodium sulphates, the alkalis most common in the subsoil of Minnesota and States farther west. It has been found that the most highly resistant standard portland cements will last up to 10 times as long as cements of low resistance under identical conditions of exposure to these chemical compounds. It has been determined also that the sulphate resistance of the concrete can be increased considerably by addition of calcium chloride in proper proportion when the concrete is being mixed, if followed by curing of the concrete in moist air at temperatures of 100° to 150° F. It is now common practice at many commercial tile plants to cure their products within this range of temperatures, and use of the calcium chloride admixture would increase the cost of the tile very slightly—about one-fifth of a cent per foot for 6-inch tile.

The later studies have made it possible to predict with some degree of accuracy, from standard absorption tests, the frost resistance of clay tile from the 23 plants in Minnesota and Iowa that supply nearly all of the clay draitile used in Minnesota. The development has greatly simplified the testing of such tile and is having an effect in bringing about a general improvement in the quality of the clay tile sold in that State.

### SOIL-EROSION CONTROL

The soil-erosion control studies were transferred to the Soil Conservation Service on April 1, 1935. It seems fitting, therefore, to review here briefly the work of the Bureau of Agricultural Engineering along this line.

The first experimental work by the Department of Agriculture in control of soil washing was started in 1903, by Drainage Investigations of the Office of Experiment Stations, the predecessor of the Division of Drainage in this Bureau. The experiment, located on a farm in Georgia, consisted of laying tile drains at the foot of a slope where serious gullying had developed, for the purpose of giving the soil greater stability by carrying off the surplus water. After the drains were laid the gullies were filled and the field planted. The experiment was continued for 2 or 3 years; the results indicated that tile drains are an aid in controlling erosion under certain conditions.

The first comprehensive treatment of the subject was issued in 1917 as Department Bulletin 512 entitled "Prevention of the Erosion of Farm Lands by Terracing", based on extended field investigations carried on by drainage engineers of the Office of Public Roads and Rural Engineering. This bulletin described the various types of terraces and their construction, stressed the advantages of the broad-base, level-ridge terrace, and discussed briefly the use of vegetation to control erosion. Farmers' Bulletin 997 entitled "Terracing Farm Land", based on the information contained in Department Bulletin 512, was published in 1918. This has been superseded by Farmers' Bulletin 1669, Farm Terracing (1931). Farmers' Bulletin 1234 entitled "Gullies—How to Control and Reclaim Them", issued in 1922, describes the construction and use of dams to check enlargement of gullies and cause filling of them by deposition of silt carried in the water flowing through them. These two Farmers' Bulletins have been widely distributed and have been used as a guide in the construction of terraces and soil-saving dams on about 20,000,000 acres during the past 20 years.

Recommendations for the terracing of eroded fields on individual farms, based upon instrumental surveys, were made in 1917 and several years following, by drainage engineers of the Office of Public Roads and Rural Engineering.

Experiments to determine the rates of loss of soil from cultivated fields, the relation of those rates to the intensity of rainfall, and the effects of different crops in the control of erosion, were instituted near Raleigh, N. C., in 1924, by the Division of Agricultural Engineering, Bureau of Public Roads, in cooperation with the North Carolina Agricultural Experiment Station. Equipment was provided for catching and measuring the losses of water and of soil from small plots. These experiments were continued until 1929, and were one of the first



attempts to determine accurately the rate of loss of soil from cultivated land due to water erosion. The results obtained at that station formed the basis for some of the more extensive experimental work carried on subsequently.

In the fall of 1928 the Division of Agricultural Engineering in cooperation with the Chamber of Commerce of Guthrie, Okla., established a soil-erosion experiment farm of 160 acres near Guthrie, and began a program of investigations relating to engineering methods of erosion control. The act making appropriation for the Department of Agriculture for the fiscal year 1930, approved February 16, 1929, provided a special fund for studying soil erosion and its prevention. That fund was apportioned to the Bureau of Chemistry and Soils, the Forest Service, and the Division of Agricultural Engineering, Bureau of Public Roads. The Division of Agricultural Engineering and the Bureau of Chemistry and Soils planned, under this fund, a program of cooperative research to be conducted upon the Guthrie erosion-experiment farm and similar experiment farms to be located in areas of different soils where erosion is serious. Such farms have since been established at Temple and Tyler, Tex.; at Hays, Kans.; at Bethany, Mo.; at Statesville, N. C.; at Pullman, Wash.; at Clarinda, Iowa; at La Crosse, Wis.; and at Zanesville, Ohio, where they will be representative of large areas and a wide variety in soils, climate, topography, and crops.

#### RESULTS OF THE STUDIES

The experiments in soil-erosion control by the Bureau of Agricultural Engineering have shown the following results:

The most costly losses caused by erosion are on cultivated land.

Most of the annual erosion loss from crop lands in the Southeastern States occurs in the summer months when the fields are being cultivated. For a 3-year period (1924-26) at Raleigh, N. C., 86 percent of the soil loss, 64 percent of the water run-off, and 45 percent of the rainfall occurred in the months of June, July, August, and September; only 14 percent of the erosion occurred when winter cover crops could help in controlling it.

Terraces are materially effective in reducing the quantities of soil washed from cultivated fields. Measurements on the 10 erosion-experiment farms showed that only one-fifth to one-thirtieth as much soil was lost from terraced land as from unterraced land.

Grain crops such as wheat and oats permit heavy losses between the time that seed-bed preparation begins and the time when the plants are large enough to appreciably check erosion.

A grade of 4 inches per 100 feet is probably the maximum that should be used in practical terracing work. Steeper grades are likely to permit appreciable erosion in most soils. Variable-grade terraces, with flatter grades at the upper than at the lower ends, as compared with uniform-grade terraces tend to reduce the concentration of run-off water near the terrace outlet and so to reduce the amount of soil and water carried off the field. Level terraces conserve soil and water better than do graded terraces, but on impervious soils often cause damage by excessive wetness to crops in the terrace channel. They are also more difficult to construct and maintain.

Short terraces are preferable to long terraces because soil losses increase with length of terrace; terraces laid out to carry water from the middle to both sides of a field will better conserve the soil than terraces laid out to carry all water to one side of the field.

Wide spacing of terraces gives less effective control of erosion than close spacing. The best spacings from the standpoint of water conservation and economy are yet to be determined for different ground slopes and soil types.

A silt-sampling device to measure accurately the quantities of water and of soil carried in a drainage channel was developed by Bureau engineers and has made it possible to obtain accurate record of the losses from individual terraces and from terraced and unterraced fields as required for the experiments.

#### FARM-OPERATING-EFFICIENCY INVESTIGATIONS

The work on this project during the past year has followed the procedure previously developed for ascertaining the nature and extent of engineering improvements needed in order to make the farms in the different parts of the country most profitable and satisfactory. Planning for this end requires consideration of all phases of the farm business—fields, crops, livestock, machinery,

and buildings—in relation to each other and to economic conditions and in relation to the farm home. Planning and carrying out the improvements, and determining the benefits that result from them, requires also the cooperation of farm-management specialists and of the farm owners.

During the past several years engineering surveys have been made, and in cooperation with farm-management specialists of the State agricultural colleges there have been prepared complete development plans for 108 separate farms in Virginia, North Carolina, South Carolina, Georgia, Ohio, Michigan, and Minnesota. As the improvements are made, over a period of some years on each farm, the farm owner is to keep such detailed records as will show not only the cost of making the improvements but also the benefits that result in reducing the cost of the products he sells and in increasing his net returns.

During 1935 it has been found advisable to devote considerable time and thought to the building situation on farms in Ohio. In that State the value of the farm buildings is comparatively high, sometimes exceeding the value of the land. Under such circumstances it is evident that the equipment represented by the buildings is one of the important factors in determining the farming program and the extent of production in certain lines. However, many of the buildings were erected some years ago when the farming program was entirely different from what it is now and consequently are unsuited for the present needs of the farm. In such cases one of the major problems in farm development is what new buildings should be constructed and what remodeling of present structures will be profitable.

On one of the Ohio farms surveyed was a barn that had been built some 30 years ago when a large number of horses were kept. The horses had been reduced to two, and most of the space formerly used for stables was practically waste. The feed room, passageways, and mangers were not conveniently located. The owner had decided that he needed a new barn, and he desired also to build a poultry house that he might increase the size of his flock. The old barn, except the roof, was in excellent condition. A plan for remodeling it, at only a small part of the cost of a new barn and poultry house, made provision for all of the livestock, including the additional poultry, and an equal amount of storage space for forage, and was much more conveniently arranged than the old structure. It is anticipated that further study will show how these farms can be arranged and operated to decrease production costs, possibly by increasing the sizes of fields and obtaining better proportions between crop acreage and available power.

Cost accounts are being kept on all the farms and information as to the benefits received from the adoption of the development plans is slowly accumulating. Many of the landowners have been unable to make much progress with their programs because of the distressed condition of agriculture, but all have expressed themselves as being intensely interested in making improvements as rapidly as financial conditions will permit.

## FARM-STRUCTURES INVESTIGATIONS

### FARMHOUSE IMPROVEMENT

An increasing interest in the farm home has been evidenced during the past year by the number of farmer requests for information on this subject. This increase in interest doubtless is a result of the increase in farm incomes, the educational efforts of the Department and of the Federal Housing Administration, and the extension of electric-power lines through rural districts, as well as of a realization that at least part of the increased income can well be spent in ways that will give the farmers better living conditions and will help to maintain farm income by providing employment for purchasers of farm products, but will not add to surpluses by increasing crop or livestock production.

This Bureau is undertaking to provide farmers with information on the best types of farm homes and the best ways of making home improvements. Farmers' Bulletin 1738 entitled "Farmhouse Plans", prepared as reported last year and published in October 1934, has been very well received and about 215,000 copies were distributed to farmers during the remainder of the fiscal year. The popularity of the publication perhaps is due to its recognition of the dual character of the farmhouse, as both a home and a center of the farm business, which necessitates features that are not required in a city house and that usually are overlooked by persons not familiar with farm conditions; and to the inclusion of plans for houses so arranged that small livable units can be



built first and other rooms added as funds permit, to develop a convenient dwelling of pleasing appearance. Most farm homes, except the very smallest, have been built by making additions to earlier small houses, but the results often have been unsatisfactory because the additions were not planned for when the original houses were built. Working drawings of the houses in the bulletin have been prepared, and the agricultural colleges in 38 States have been furnished with master sets from which they can make blueprints for the farmers in those States.

In most existing farmhouses there is still much value, though they are not arranged or equipped for easiest accomplishment of the work to be done in them. To repair, modernize, or remodel these homes is usually less costly than to build satisfactory new ones, but to achieve a satisfactory result requires for each remodeling job a separate study of the house, its surroundings, and the requirements of the owner and his family. No Federal or State agency is in position to undertake this individual service, and comparatively few architects, engineers, or builders have training and experience in this sort of work. To meet this situation as far as practicable, *Farmers' Bulletin 1749*, entitled "Modernizing Farmhouses" (now in press), has been prepared to assist farm people in planning their own improvements. The publication will give general information concerning the advantages and costs of various improvements such as water and plumbing, electricity, and heating equipment; additions of living space, closets, and cellars; and changes in exterior appearance. The bulletin also presents plans and cost estimates for remodeling 18 houses selected as representative of the styles of houses most used on farms in the United States, together with plans and records of cost of work done by the owners in remodeling 13 of those houses. One of the last is the subject of a moving picture and a film strip that have been used extensively in the rural campaign of the Federal Housing Administration as well as by college extension services. This material is especially timely, because for a period of years farmers have curtailed spending on their homes and many soon will be forced to make improvements to preserve the usefulness of the buildings.

#### REPAIRS FOR FARM BUILDINGS

The farm-housing survey of 1933-34 showed structural repairs and replacements to be more generally needed than any other kind of farmhouse improvements. Of the houses surveyed, 25 percent needed foundation repairs and 16 percent more needed new foundations, 26 percent needed roof repairs and 17 percent more needed new roofs, 50 percent needed repair or replacement of interior walls and ceilings, 38 percent needed repair or replacement of floors, and 55 percent needed outside painting. Of the nearly 30,000 farms visited by the survey engineers, some 43 percent needed extensive repairs to barns and other service buildings, 69 percent needed paint, and 71 percent needed repairs to fences.

The first of a series of publications on various kinds of repair work is *Farmers' Bulletin 1751* entitled "Roof Coverings for Farm Buildings and Their Repair", now in press. This bulletin gives up-to-date information on the types of roofing commonly used on farm buildings, their suitability for use under various conditions, and the comparative cost and durability. Manuscript for a bulletin on foundations for farm buildings and their repair is now in preparation.

#### EQUIPMENT FOR FARM BUILDINGS

The results of an investigation of farmer-owned milk-cooling outfits during a period of 3 years, made cooperatively with the Bureau of Dairy Industry, was published as circular 336 entitled "Cooling Milk on the Farm with Small Mechanical Outfits." Information is given on costs of operation, including comparisons of iced and mechanically operated coolers, on selection and installation of equipment, and on constructing a home-made storage tank and a home-made dry box for use with mechanically operated cooling units.

Extensive tests of oil burners for home heating were made during the year, continuing work that has been carried on by the Bureau for several years. The latest tests of gun-type burners showed higher efficiency than earlier tests, as a result of improved atomizer design and air-fuel mixture. The ignition characteristics of blue-flame rotary burners tested were better than in previous tests, as the result of redesigning the hearth on which the air and oil impinge, but showed a slight loss in thermal efficiency. A retort-

type burner operating on a principle previously tried and discarded by several manufacturers performed satisfactorily in the test.

The most interesting finding of the tests was that marked improvement in the thermal efficiency of oil burners in ordinary cast-iron boilers can be obtained by the use of "economizing" units or heat-absorbing baffles. Several commercial devices of this kind gave good results, and a simple and efficient type was designed by Bureau engineers who have applied for a public patent on it. These devices promise to be of value by obtaining satisfactory operation of oil burners in heating boilers that otherwise would give low operating efficiencies. A report of the tests is being prepared for Department publication.

#### STORAGE AND TRANSPORTATION OF FARM PRODUCTS

Potato-storage investigations were continued at Presque Isle, Maine, in co-operation with the Maine Agricultural Experiment Station and the Bureau of Plant Industry. Farm tests of the practice of curing potatoes by holding them at about 60° F. for the first 2 weeks after storing, as recommended by the Bureau of Plant Industry as the result of laboratory tests, gave good results. Warming potatoes from the winter storage temperature of 40° to about 50° just before grading for shipment again was found to reduce grader damage and improve table quality. This warming can best be done in houses with vent flues or slotted racks under the potatoes and is aided by the use of a fan or blower to force warm air through the bins. Practical suggestions based on results of this study were issued as a mimeographed circular entitled "Management of Maine Potato Storages", by the extension service of the University of Maine.

In remodeling old cellar storages and constructing new storages to obtain a large increase in capacity required for the 1934 crop, many farmers followed Bureau recommendations to insulate the roof and eliminate the upper floor commonly used for storing machinery. The enlarged bins, extending from the basement floor to 4 to 8 feet above the eaves, provide at least 75 percent greater storage space for potatoes without increase of floor plan or of roof area. Heavily insulated storage-house walls built without spaces for air circulation, in order to avoid moisture condensation within the walls, were found unsatisfactory; therefore a comprehensive test of wall sections is planned for the coming season to find a type of construction that with reasonable cost will provide the insulation required and not be damaged by moisture.

At Arlington Experiment Farm, Va., additional simultaneous measurements were made of the heat of respiration, the carbon dioxide production, and the moisture production of fruits and vegetables, using the special respiration calorimeter. Tests with several fruits and vegetables at 64° F. indicate that the heat evolved at this temperature may be calculated within 10 to 15 percent on the basis of the carbon dioxide given off, assuming that it is sugar which is burned in the production of the carbon dioxide. Tests with products at other temperatures are to be made. Knowledge of the relationship between the heat given off and the carbon dioxide produced will be useful, because measurement of the carbon dioxide is easier than measurement of the heat, and in the past calculations of the refrigeration and precooling requirements of fruit and vegetables have been based on measurements of carbon dioxide. Storage conditions on a boat loaded with citrus fruit en route from California to New York via the Panama Canal were studied, in cooperation with the Bureau of Plant Industry, and the boat owners. Changes in the air-circulating system of this ship, made in accordance with recommendations based on this study, have resulted in improved quality of fruit delivered in succeeding shipments.

The low-velocity thermocouple anemometer has been used successfully for measuring air circulation under numerous difficult situations, and instruments have been loaned for scientific uses to other Government, State, and private agencies.

In the transportation of apples and pears from the Northwest in winter, the danger of overheating is as serious as that of freezing, and improved methods of producing and distributing heat in cars are being sought in co-operative tests with the Bureau of Plant Industry and transportation companies. A new principle which gave good results when applied in tests last winter was the moistening of the air in the car by evaporating water on the heaters. The moisture condensing in the cold parts of the car gave up its latent heat and thus held temperatures in the different parts of the car more



nearly uniform than where no moisture was added. This solution of the problem seems correct in principle, but practical application to commercial shipments has not yet been worked out.

## FARM-MACHINERY INVESTIGATIONS

### CORN-PRODUCTION MACHINERY

In the corn-production-machinery studies the plan has been to adopt a program of cropping and soil management approved by the agronomists, then to work toward finding the most economical and satisfactory machines and methods for carrying out the processes of seed-bed preparation, planting, cultivating, and harvesting. This project has been conducted in cooperation with the Iowa Agricultural Experiment Station.

In seed-bed preparation cornstalks or other residue of the previous crop often cause difficulty in plowing. Disking the stalks before plowing has involved only about half as much labor as raking and burning. Disking before plowing has been beneficial for covering trash, under normal rainfall conditions, but under dry conditions in 1934 was detrimental. Harrowing cornstalks when frozen and brittle before plowing was beneficial. Two types of disk jointers developed by the Bureau have enabled plows to cover cornstalks well, under normal conditions, without any work on the stalks previous to plowing. In comparative tests of a moldboard plow and a pulverator over a period of 4 years there was no measurable difference in value of the work done under normal conditions, but the pulverator prepared the seed bed better under very wet or very dry conditions. Plowing cost less than pulverating. For work on the soil between plowing and planting there was no difference between a disk harrow and a duck-foot field cultivator, as measured in stand of corn, weed control, or yield, in tests covering 4 years. The disk harrow is lower in cost and more generally useful than the duck-foot cultivator.

This study has developed two methods of improving the accuracy of check-rowing with a four-row planter. One method handles the check wire in the conventional way except for setting the stake that holds the wire at the end of the field about 18 inches off the center line of the planter. The other method uses a pay-out stake which keeps the tension constant as the planter approaches the end of the field. The special stakes are rather awkward to handle, but make it possible to secure almost perfect checkrowing.

In corn checked 42 by 42 inches, 30 by 30 inches, and 21 by 21 inches, it was somewhat more difficult to cross-cultivate and control weeds with the narrow spacing. Labor in planting and cultivating was about in inverse proportion to the width of the implements used, regardless of row spacing. Under the very dry conditions in 1934, yields were slightly better from the standard 42-inch than from the closer spacings, whereas in 1933 the 21-inch spacing produced the best yield. Use of disk furrow openers on the planter under dry conditions in 1934 resulted in considerably better stand of corn and slightly better yield than surface planting. Under wet conditions in 1935, however, there was no difference in stand. It was somewhat easier to control weeds with furrow planting.

To obtain comparisons with respect to effectiveness and economy, tests are being made of a spring-tooth weeder, a rotary hoe, a spike-tooth harrow, a cultivator with rotary weeders near the row and sweeps between rows, and a cultivator with two pairs of disk hillers near the row and sweeps between rows. The first three of these have been very effective in killing small weeds when the ground surface is lightly crusted by moderate rains, but have been ineffective both when the soil remained dry and loose in 1934 and when it was packed by intense rainfall in 1935. These implements caused excessive injury to corn plants if used when the plants were very small and tender. The cultivator with rotary weeders and sweeps was very effective and dependable for early cultivation and could be used satisfactorily at any stage of growth of the corn and in any workable condition of the soil. The cultivator with double-disk hillers was very effective in killing weeds after the corn had grown about 4 inches high, but was not well adapted to earliest cultivation.

In harvesting, because of the short crop in 1934, a large part of the corn on the experiment farm was cut for fodder. With a binder the labor of cutting and shocking was about half that with hand cutting, but even so amounted to 1.6 man-hours per ton of cured fodder. Husking from the shock and hauling ear corn and stover to storage used 6.3 man-hours per ton of fodder when the husking was done by hand under good conditions in November; similar work

done with a husker-shredder operating in February under less favorable conditions required 6.7 man-hours per ton. High labor requirements and difficulty in curing appear to be obstacles to extensive harvesting of corn fodder in Iowa.

Standard corn pickers in tests, except under unusually favorable conditions, have lost considerable quantities of corn in the field. A new type of snapping-roll unit was invented by Bureau engineers, and an experimental unit was built and tested in comparison with a regular type. The wastage of shelled corn due to snapping-roll action with the new type was less than one-sixth as great as with the regular snapping rolls.

#### COTTON-PRODUCTION MACHINERY

Studies of machinery used in growing cotton are being continued on the Greenville sandy loam near Prattville, Ala. They include comparisons of 37 methods of seed-bed preparation and 27 methods of cultivation, and investigations as to the power required for operating different implements, the physical changes in soil produced by tillage operations, and the effects of the different implements upon root development, plant growth, and weed control.

These studies show that seed-bed preparation can easily pulverize this soil sufficiently to reduce the crop yield. Characteristics of a good seed bed at planting time in this soil have been found to include a cloddy structure having an apparent specific gravity of 0.5 and lumps of such size that 35 percent of the soil will be held by a sieve of 1-inch round holes. This condition can be obtained by throwing up loose cloddy beds 60 days before planting and letting them weather. The planting and cultivating operations should preserve this open structure. Cultivation is beneficial in this field only through conserving moisture and plant food by keeping down the weeds. Crop yields increase with the number of shallow cultivations up to, and only to, the point where control of weeds is reached. Three properly timed machine cultivations were sufficient on the Prattville field in each of the three past seasons. Keeping the weeds hoed out without any machine work after planting produced as much cotton as six deep cultivations and only slightly less than three shallow cultivations.

Cross-row cultivation with a rotary hoe, spring-tooth weeder, or drag harrow was found to be of value in early weed control. For average conditions they enabled extending the chopping time and did not reduce the number of plants below that necessary for a stand. The rotary hoe was especially valuable in breaking up soil crusts and getting up a stand of cotton after a packing rain.

The scope of the investigations with cotton-production equipment at Auburn, Ala., in cooperation with the State Agricultural Experiment Station, has been greatly enlarged by the recent construction of the Farm Tillage Machinery Laboratory. The special equipment so far obtained for making the tests in the nine big soil bins consists of a unit upon which to mount the soil-working tools, a power car for pulling the unit with the tools, and a specially designed dynamometer for measuring the three components of the draft. The power car is mounted on rubber tires, is equipped with a 135-horsepower engine, and is capable of speed variations of from 0.2 to 10 miles per hour.

#### SUGAR-BEET-PRODUCTION MACHINERY

The investigations of sugar-beet machinery have been continued in cooperation with the agricultural experiment stations of Colorado and California. Tests conducted on beet harvesters put out by several manufacturing companies have resulted in redesigning and improving those harvesters to such a degree that it seems a mechanically and economically acceptable machine will be produced in the very near future. Hand harvesting requires a great amount of arduous labor in a short period, which a suitable machine could accomplish easily and at a lower cost.

Experiments in the development of a hill planter for beets have seemed to show the possibility of getting better stands of beets while using one-third the usual quantity of seed. Commercial manufacturers are building hill planters, and there are indications that this principle of planting can be carried further so that mechanical thinning might replace hand thinning which calls for a large labor supply. A small knife has been devised for strapping to the hand of a laborer so that he can thin beets without using the hoe, and thus have both hands free for the thinning operation. Use of this knife has resulted in an improved stand of beets.



## PEST CONTROL

In corn-borer control the development and testing of trash-covering equipment for plows was continued during the year, in cooperation with the Bureau of Entomology and Plant Quarantine and the agricultural experiment stations of Ohio and Illinois. The experimental self-aligning disk jointers and trash guides were used by cooperating farmers in plowing approximately 1,200 acres near Toledo, Ohio, and near Urbana, Ill. A patent covering this jointer was granted, assigned to the Secretary of Agriculture. It is hoped that manufacturers of farm machinery will be interested to make these attachments for their plows. Advantages of the self-aligning disk jointer over the moldboard jointer and colter are (1) simplicity of adjustment, (2) effectiveness in cutting through trash, (3) reduction in plow draft, (4) a furrow section that helps hold the furrow slice from rolling back into the furrow after being turned, (5) less spill over the back of the moldboard when plowing deeply in loose soil, (6) a swiveled connection that permits swinging to the side when an obstruction is encountered, and (7) cheaper maintenance of the wearing parts.

Several kinds of alloys for use on points and cutting edges of plowshares are being tested under field conditions near Toledo. The tests have not been sufficiently extensive to give conclusive results, but they indicate that the use of two grades of one type of material doubles the service of a soft-center steel share.

Tests with a combination corn picker and chopper to determine the effectiveness of the machine in killing borers in cornstalks during 1932 to 1934 showed a kill of 95 to 98 percent for a light infestation (3,000 to 8,000 borers per acre) and 92 to nearly 95 percent for a heavy infestation (39,000 to 117,000 borers per acre). Plowing of standing stalks with suitable equipment, however, results in a cleaner job. A wheelbarrow-type sprayer was redesigned and constructed for use in spraying sweet corn in Connecticut.

Orchard burners tested for control of apple flea weevil at Medina, Ohio, were very ineffective. The cost for labor and fuel was about 50.2 cents per tree. Excellent results were obtained by spraying with fluosilicates, at less cost. Burning for control of apple scab at Augusta, Mich., cost 43 cents per tree for labor and fuel, but was not effective. Burning for killing grape berry moth pupae in vineyard trash was found impracticable.

Work on poison distributors for Japanese beetle control and with soil-tillage implements for mechanical destruction of the grubs was continued at Moorestown, N. J., in cooperation with the Bureau of Entomology and Plant Quarantine. A belt-conveyor type of feed is showing considerable promise of obtaining even distribution of poison in the soil. A Swedish roto-tiller was fitted with additional knives, and in 1 to 3 times over the ground at normal and at 3-inch depths destroyed 69 to 94 percent of the grubs. Plowing with a moldboard plow followed by double-disking 1 to 3 times obtained 69- to practically 75-percent kill.

The investigation of spraying equipment and methods for pecan orchards has been continued, at Albany, Ga., in cooperation with the Bureau of Entomology and Plant Quarantine, the Bureau of Plant Industry, and the Bureau of Chemistry and Soils. In pecan spraying in the Southeast, ordinarily a pressure of about 300 pounds per square inch is used. Low-pressure nozzles would permit the use of rotary or centrifugal pumps, eliminate valve troubles, and lower power requirements. Several such nozzles of different types used in the industrial field were tested. A nozzle of special design was constructed, which gave a spray pattern indicating nearly complete coverage. It now appears that best results with low-pressure equipment may be obtained with a nozzle of large capacity and wide spray angle, elevated to overcome the limitation in range so that the spray can penetrate the tree in a direction paralleling the branches. Because most spray materials seriously corrode most metals and alloys, samples of various metals and alloys were exposed separately in the two most corrosive materials used in spraying, bordeaux mixture and lime-sulphur solution. Of 17 representative materials tested, the nickel and chrome-nickel group were most resistant to both of the spray solutions.

The pink bollworm control studies at Presidio, Tex., in cooperation with the Bureau of Entomology and Plant Quarantine and with the State agricultural experiment station, included development of field clean-up machinery, mechanical application of insecticides, and effect of plowing and irrigation. The plowing investigations have been brought practically to a close. Practi-

cally all the tests have shown that early plowing followed by an immediate irrigation is very effective, whereas early plowing with several months delay before irrigation is extremely unsatisfactory for control. Attention now is being directed largely toward development of equipment for cleaning fields of the cotton-crop debris which harbors the overwintering stages of the worm. The push-type cotton-stalk shaver was further developed, and in the clean-up campaign was shown to be considerably more economical for cutting stalks than hand labor. Plans are being made for construction of a push-type rake to bunch the cut stalks into piles for burning. Hand picking of the surface trash was partially superseded by use of a close-toothed hand rake developed during the latter part of the clean-up work. A small model suction cleaning device showed promise in tests, and plans have been made for constructing a larger model for field tests. Two types of dusting machines showed increase in degree of coverage with increase in number of discharge outlets but lacked uniformity in the rate of delivery. The first model of an apparatus for atomizing and vaporizing nicotine sulphate was completed. Farmers' Bulletin No. 1729 entitled "Machinery for Dusting Cotton" was issued in collaboration with the Bureau of Entomology and Plant Quarantine.

#### FERTILIZER-DISTRIBUTING MACHINERY

Observations indicate that failure to obtain a good stand of plants and vigorous early plant growth may be due in many cases to improper placement of fertilizer. The equipment and methods sometimes employed do not permit the most efficient use of commercial plant food. The purpose of the fertilizer-machinery investigations is to determine, for the farmer and for the implement designer, what placement of fertilizer with respect to the seed or plant will insure greatest crop returns from the fertilizer applied. The studies have been carried on in cooperation with the Bureau of Plant Industry, the Joint Committee on Fertilizer Application, the National Fertilizer Association, and State experiment stations in Georgia, Louisiana, Maine, Maryland, Michigan, Mississippi, New Jersey, New York, North Carolina, Ohio, Oklahoma, South Carolina, Texas, and Virginia.

Field experiments were made with peas in addition to those with cotton, beans (white, snap, and lima), potatoes, cabbage, sugar beets, tobacco, and tomatoes as in the previous year. Placement of the fertilizer with respect to the seed has been definitely indicated to be an important factor in obtaining most efficient utilization of the material.

The data obtained in the past year confirm the indications of prior experiments that placement of the fertilizer in bands at one or both sides of the plant rows and slightly lower than the seed generally gives most rapid germination of seed and growth of plants as well as highest yield of crop. With cotton, the most favorable placement was  $2\frac{1}{2}$  inches to the side and 2 inches below the seed; with beans, 2 inches to the side and slightly below; with potatoes, 2 inches to the side and level with the seed piece. The importance of accurate placement was indicated in the experiments with potatoes, in which a side placement on the seed level gave a yield of 24 bushels per acre more than a similar placement 2 inches below seed level. Placements under the seed usually gave unsatisfactory results. Placement under the seed disturbs the soil structure so that immediate rainfall may be needed to reestablish the capillarity. Placement to the side of the row permits planting the seed in undisturbed soil.

The findings of these experiments have attracted the attention of growers, whose demand for equipment to distribute and place the fertilizer accurately is being reflected in improved designs of planters and fertilizer distributors being put out by manufacturers. Improvements of this kind have been made in equipment on the market for planting cotton, potatoes, and beans. Machinery manufacturers are naturally reluctant, however, to make changes in design of their products until the necessity for such change is established by experiments determining the requirements of the crops. Lack of such evidence with respect to a number of crops suggests that the studies of fertilizer placement should be continued.

#### FORAGE-CROP DRYING

The forage-drying studies at Jeanerette, La., have been continued, as before, in cooperation with the Bureaus of Animal Industry and Dairy Industry. Improvement in the appurtenant equipment of the rotary-drum drier has been made by modifying the arrangement of drives, motors, hay-unloading device, and



conveying equipment for greater convenience in operation. The experimental vertical-stack drier built last year, though tested with various kinds of forage, was found unsatisfactory and abandoned. The hot gases could not be forced through the moving ribbon of forage in a way to give uniform drying. The most satisfactory type of forage drier seems to be that in which the material to be dried is held or carried suspended in the drying air or gases. This type requires a minimum of heavy and fast-moving parts. A vertical-cylinder drier of this type, 9 feet tall and 4½ feet in diameter, has been built as an experimental unit. In this the chopped forage drops successively through four hoppers upon intervening sheet-metal disks that revolve about the axis of the cylinder. The furnace gases enter the top of the cylinder and pass downward with the forage in a zigzag path to the bottom of the drier, where a fan draws off the mixture.

Observation on the drying of sweet clover (*Melilotus indica*) and screened sugarcane pulp in a private rotary-drum forage drier indicated the former material was unusually difficult to dehydrate, for the efficiency factor obtained was only about 38 percent, whereas the efficiency with the cane pulp exceeded 50 percent.

This cooperative project has so far furnished to the Bureau of Dairy Industry almost 200 tons of dehydrated forage, made up chiefly of alfalfa, soybeans, cowpeas, and native grasses and clovers, and to the Bureau of Animal Industry something more than 50 tons of dehydrated soybeans. This forage has been used in large-scale feeding tests with dairy and beef cattle. The cost of fuel, power, and labor for drying has varied from \$4.50 to \$11 per ton. In the last of these tests conducted by the Bureau of Animal Industry, the dehydrated hay showed an advantage of 7 percent over the sun-cured product.

#### SEED SCARIFIERS AND CLEANERS

The complete report of the study of seed scarifiers for increasing the germination percentage of hard-coated seeds was published as Circular No. 345 entitled "Barrel and Disk Seed Scarifiers." This describes the disk scarifier, which was developed by engineers of the Bureau for scarifying on a scale suitable for seed dealers, and supplements Leaflet No. 107 entitled "The Barrel Seed Scarifier" issued in November 1934. The results of the tests of farm-size seed cleaners for combating stinking smut were published as Circular No. 361 entitled "Removing Smut Balls from Seed Wheat."

#### SEED TREATERS

Tests of several commercial types of grain treaters showed that many such devices are inaccurate in feeding the fungicide dust to the seed grain, and are difficult to adjust. In feeding dust mechanically from a supply hopper, it was found that the rate of feeding frequently varied with variation in the depth or "head" of material in the hopper. To overcome this difficulty, Bureau engineers devised a feeder with offset hopper in which the head of dust over the discharge apparatus remains constant, so the rate of feed is not influenced greatly by the amount of material in the supply hopper. Another mechanism developed for the same purpose is a "two-stage" feeder in which the fungicide dust flows through a perforated disk in the hopper bottom and is checked by piling up on a lower disk until the accumulation on the second disk is wiped off mechanically. Both of these feeders are of simple construction, and a ½-horsepower electric motor served for operating them in the tests. Bureau engineers have devised also a machine which automatically feeds the predetermined quantity of fungicide dust as it weighs out the grain. The weight of the grain operates all moving parts. Preliminary tests of the device with wheat, oats, and barley indicate satisfactory performance.

#### SPECIAL HARVESTERS

The regular grain combine has proved unsuitable for harvesting soybeans in the Mississippi Delta area, because of the rank growth of the plants, the prevalence of weeds, and the succulent condition of the vines at harvest time. Such machines are also too expensive for general use in many areas east of the Mississippi River. As a result of experimental work conducted by the Bureau, several manufacturers have begun work in developing small, low-cost combines, and investigations are under way to determine the adaptability of these

machines for harvesting soybeans as well as cereal grains and certain legumes. The development of a simple, inexpensive, one-row soybean harvester also is in progress.

Because the toxic material in pyrethrum flowers is not harmful to human beings, spray materials containing it may supplant some poisonous chemical sprays now used on fruits and vegetables. The production of pyrethrum in the United States depends in part upon the development of a machine for harvesting the crop economically. The pyrethrum flowers used in the commercial production of insecticides are imported from countries where human labor is employed at low cost. In cooperation with the Bureau of Plant Industry a cotton stripper of the type commonly used in northwest Texas, with certain alterations, was tested and found to harvest the pyrethrum successfully when the flower stalks were reasonably upright. In fields where the plants are badly lodged, a pick-up attachment appears to be necessary. Further alterations of the machine are in progress for adapting it to harvesting this crop.

### COTTON-GINNING INVESTIGATIONS

The Department's cotton-ginning laboratory at Stoneville, Miss., is ginning approximately 6,000 lint samples from each year's crop, using some scores of lots of cotton representing numerous varieties, different methods of harvesting, and a wide geographical range. Many of the tests each year have repeated those of prior years, to extend the particular studies over a sufficient period to embrace every likely variation in crop and ginning conditions. The first experiments on any phase of the subject are likely to be of an exploratory nature and not dependably indicative of conclusions. The operation of the ginning and fiber laboratories at Stoneville is on a permanently cooperative basis with the Bureau of Agricultural Economics.

#### DRYING SEED COTTON

The test data on effect of artificially drying seed cotton merely corroborated the results of previous years, showing lint-value improvements averaging 8 percent for wet long-staple cottons and 2 percent for wet short-staple cottons, according to central-market prices. The cost of drying, with the vertical drier and the "Government" process developed by the Bureau, was about 0.5 percent of the lint value for the short cottons, and very slightly greater for the long cottons. The practice of artificially drying seed cotton is becoming increasingly common, and available information indicates that at least 250,000 bales of the 1934 crop were dried at public gins with the Government process and vertical drier. The studies showed drying the cotton to have reduced the power necessary to operate the gin stands by 14 to 23 percent, and some operators of commercial vertical-drier installations have reported that the saving in power required by the gin stands was sufficient to operate the drier. The ginning plants that dry wet seed cotton continue to show reduction in chokages and shut-downs of machinery, maintenance of good-weather capacity throughout the season, and better cleaning and extracting, than plants ginning wet cotton without drying. Tests have shown that this drying does not affect the germinating qualities of the seed unfavorably. Drying seed cotton has not reduced the weight of lint ginned by as much as the weight of moisture removed, because the gins have been able to remove the fiber from the seed more thoroughly than when ginning wet cotton.

#### CLEANING AND EXTRACTING

Studies with cleaners and extractors during the past year showed, as was expected, that greater improvement in quality of the ginned lint was obtained from the more elaborate than from the simpler machinery combinations, and greater with seed cotton containing much foreign matter than with seed cotton containing little foreign matter. With picked short-staple cottons the lint improvements averaged one-third of a grade for cottons with 2-percent trash content and two-thirds of a grade for cottons with 4-percent trash content. For snapped short-staple cottons containing 25 percent of foreign matter the improvement was one and one-half grades when 22 cleaning cylinders and 2 extractors were used. The effectiveness of any particular cleaning and extracting equipment decreased as the staple length of the cotton increased. Such machinery did not affect the staple length significantly except long-staple cottons subjected to extracting when green, damp, or wet. Effective



cleaning and extracting of snapped cottons reduced appreciably the time required for ginning, and the energy consumed in the gin stands.

Because of the difficulty of cleaning and extracting long-staple cottons, a fractionation device and method were invented that greatly simplify the work of determining accurately the trash content of seed-cotton and cotton-lint samples. Patent No. 2002974, covering the device, has been granted to Charles A. Bennett and George E. Gaus, of the laboratory staff.

#### FEEDING METHODS

In the Southeastern States plain gins are still used ordinarily, and cleaning equipment is to be found in a very small percentage of the ginning plants. To obtain definite information as to the value of somewhat more elaborate machinery for such conditions, tests were made to compare plain gins with huller-front gins and to compare unit-extractor feeders with the ordinary cleaning feeders for use on plain gins, using cottons from the central and eastern Cotton Belt. Trash removal both by the huller-front gin and by the plain gin with hull-extractor feeder was much greater than by the plain gin with small-drum cleaning feeder. The differences in grade averaged about one-half a grade for the short cottons, in which the trash content averaged about 4 percent.

#### RATE OF GINNING

It has previously been demonstrated at the cotton-ginning laboratory that fast ginning, obtained by feeding the cotton to the gin stand fast enough to maintain a tight seed roll, produces a lower grade of lint than ginning with a loose seed roll. The average difference for short-staple cotton is about one-third grade and that for long-staple cotton up to about a full grade. Gin-saw speed, within the range from 100 revolutions per minute below to 100 revolutions per minute above the speed recommended by the gin manufacturer, has been found to have no appreciable effect on the rate of ginning.

One objective of the 1935 investigations has been to discover a means of increasing the rate of ginning without sacrificing the higher lint quality thus far obtained only with a loose seed roll. Experiments with the small laboratory gins, equipped with 10-inch saws, seem to show that by changes in design of the saw teeth and in spacing of the saws it will be possible to materially increase the rate of ginning by existing gin stands without reducing the grade of the lint. On the small gin, an increase in ginning capacity of 20 percent was obtained by closer spacing of the saws, and an increase of about 9 pounds of ginned lint per bale (1,500 pounds of seed cotton) was obtained by increasing the pitch angle of the saw teeth.

#### EXTENSION WORK

The Bureau of Agricultural Engineering cooperates with the Extension Service and the State offices of cooperative extension work in education relating to (1) land improvement and conservation; (2) mechanical farm equipment; (3) farmhouses and service buildings; and (4) farm and home utilities. These extension engineering activities were also correlated with (1) the engineering work of over 100 emergency conservation camps assigned to erosion control under the technical supervision of engineers of the Bureau of Agricultural Engineering until transfer of this duty to the Soil Conservation Service on April 1, 1935; (2) water conservation for drought relief conducted by the Federal Emergency Relief Administration assisted by hydraulic engineering consultant service furnished by engineers of this Bureau; and (3) the engineering work of 47 emergency conservation camps assigned to drainage-maintenance work in May 1935 under the supervision of engineers of this Bureau. The Bureau has also assisted in the extension phases of the rural-housing program of the Federal Housing Administration and is now cooperating in the extension field with the program being inaugurated by the Rural Electrification Administration. It also rendered consultant service on land-measurement methods to the Agricultural Adjustment Administration and assisted the Planning Division of the same organization in cooperation with State rural rehabilitation offices to organize soil-improvement and erosion-control projects for rehabilitation clients in about 150 counties in most of the Southern States. It is also cooperating in adjustments in the Extension Service program of erosion control inci-

dent to the establishment of the Soil Conservation Service in the Department of Agriculture.

The extension work of this Bureau is a correlating service conducted cooperatively with the Extension Service in the interest of State extension engineers and other State and county extension workers, not only to make the researches of the Bureau of Agricultural Engineering available for farm use but also to facilitate the exchange of engineering developments of State experiment stations as they are introduced into extension work. In its extension work the Bureau aids extension field workers in correlating engineering recommendations and in developing methods for acquainting farmers with the use of improved practices. The aggregate achievement of cooperative extension work in engineering projects for the United States is given in the following summary of statistical reports of county agricultural agents for the past year, subdivided under the four classifications of engineering extension work previously cited.

#### LAND IMPROVEMENT

Improvement of fields by means of terracing, drainage, irrigation, land clearing, and the conservation of soil and water upon other lands was reported by county agents as a total of 2,189,361 acres of land improved or conserved by protective measures on 57,718 farms. A conservative valuation of their services to farmers in connection with this work is estimated by the agents to total \$7,503,628.

Terracing, gully control, contour cultivation, and other erosion-control measures, as usual, led in popularity. Erosion-control work on 1,608,726 acres on 40,387 farms was reported by 1,160 county agricultural extension agents who valued the savings effected by their services upon erosion-control work at \$5,656,867. The extension report for 1934 brings the statistical record of the Extension Service for the 20 years since its inauguration to a total of 19,699,203 acres on which erosion was controlled by terraces and soil-saving dams, accompanied by contour cultivation according to extension recommendations. The total number of farms involved is reported as 637,304. The engineering practices used in this program are based principally on over 30 years of engineering investigations in erosion control conducted by personnel of this Bureau prior to the transfer of this work on April 1, 1935. A widely accepted loan-appraisal value of this type of improvement is over \$8.50 per acre on southwestern land, and more where land values are higher.

#### FARM EQUIPMENT

Agricultural agents reported their assistance to nearly 17,000 farmers procuring better types of machines and using equipment more efficiently. Over 18,000 farmers were trained in adjustment and repair work on nearly 30,000 machines. There is no measure of the spread of these influences to other farmers. New crops and new methods of tillage, seeding, fertilizing, cultivating, harvesting, and storing require continuous progress in education in the practical utilization of modern mechanical farm equipment. No small part of this extension work relates to the use of implements for pest control. The Bureau researches contribute to extension information on many urgent implement and machine problems.

#### FARM BUILDINGS

Extension reports show a significant improvement in farm buildings this year. Agricultural agents aided over 31,000 farmers in planning over 36,000 new buildings according to extension plans and specifications. And over 31,000 farm buildings were improved, conforming to extension advice on over 24,000 farms. These figures include 1,978 new dwellings and 5,987 dwellings remodeled. Farmers' Bulletin 1738, entitled "Farmhouse Plans", has been a very popular and material help this year in extension work. The Bureau's farm-building-plan exchange for State extension services has made this bulletin virtually a catalog of the best types of farmhouse plans from which working drawings may be ordered by farmers from the various State agricultural colleges.

#### FARM AND HOME UTILITIES

Some increase in this work is shown in extension reports. Assistance was given by extension agents on 2,869 rural electrical installations completed. Improved home equipment was installed on over 20,000 farms with advice chiefly



from home demonstration agents, aided by home-management specialists and extension engineers. Improved farm purchasing power, an educated desire for improved farm homes, and new Government facilities to increase the rate of rural electrification all combine to stimulate increasing improvement of homes with lighting systems, running hot and cold water, plumbing, sewerage, heating plants, and home appliances. The Bureau has cooperated with other Federal agencies and bureaus to make sound recommendations on modern home improvements readily available for extension use.

### SERVICE WORK

Besides the regular activities of the Division of Plans and Service in compliance with requests from other bureaus for engineering services in preparing plans and specifications for buildings and equipment, and in supervising construction of various kinds, a number of the engineers and economists of the research divisions have made special investigations for the benefit of various Government agencies in connection with emergency recovery activities. The service work of the Bureau during the past fiscal year has included the following major items:

For the Land Use Committee of the National Resources Board, an exhaustive study of the irrigation resources, both potential and in use, of the 17 Western States.

For the Federal Emergency Relief Administration, (1) service as the technical adviser in connection with the drought-relief and water-conservation programs; (2) a study of the feasibility of providing storage reservoirs to supplement the irrigation water supply for the La Plata Basin in Colorado, the investigation determining the sufficiency of the flow in La Plata River, locating satisfactory dam sites for adequate reservoirs, and estimating the cost of the project; and (3) engineering assistance for several months in the development of water-conservation projects in New Mexico and in South Dakota.

For the International Boundary Commission, United States and Mexico, rather extended consultation service in an investigation of the availability of water for irrigation from certain international streams and of the area of irrigable lands dependent upon that water.

For the Mississippi Valley Committee, Department of the Interior, a study of the extent of damage to crops in the Missouri River bottoms between St. Louis and Kansas City caused by river floods in the period 1903 to 1934.

For the Subsistence Homesteads Division, Department of the Interior, examinations of two proposed homestead-development projects and reports setting forth the drainage improvements necessary to make the sites satisfactory.

For the Farm Credit Administration, (1) an extended study (completed in the next fiscal year) of the organization, operation, management, and financial structure of mutual irrigation companies in California and Utah, to develop information upon which proper standards can be based for loans by the regional banks for cooperatives to cooperative irrigation companies for the purpose of refinancing obligations and acquiring facilities; and (2) investigations of the irrigation situation in the Grand Prairie rice-growing section in eastern Arkansas and of the involved affairs of a certain irrigation district in California, for the benefit of the Federal land banks making loans in those sections.

For a group of municipalities and irrigation enterprises in southern California and by authorization of the Secretary of Agriculture, a study (completed in the next fiscal year) of the utilization of the waters of Mojave River and of the feasibility of storing and diverting some of those waters to the Santa Ana River basin.

For the International Joint Commission, continuation of the study that has been carried on cooperatively with the United States Geological Survey to determine what damages to agricultural lands in the Kootenai Valley in Idaho would result from construction of a proposed power development at the outlet of Kootenay Lake in British Columbia.

For the Department of War, continuation of engineering appraisals in the lower Mississippi Valley, with particular reference to flood damages in the Birds Point-New Madrid levee set-back area.

For certain communities in the humid region, maintenance of ditches of organized drainage enterprises, by 47 Civilian Conservation Corps camps located in Delaware, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Missouri, and Ohio. Establishment of the camps was in progress at the end of the fiscal year.

For the Bureau of Biological Survey, (1) services as engineer in the migratory-waterfowl program, involving during the fiscal year preliminary examinations of 54 sites of proposed refuges in 25 States, engineering surveys and construction plans for improvement and control works for 26 of those refuges, and supervision of construction on 11 refuges that have advanced to that stage of development; (2) plans and specifications for a laboratory, a cottage, a garage, and a shop at Beltsville, Md.

For the Bureau of Animal Industry, revision of plans for 3 laboratories, a shop, a storage, and 2 boiler houses at Beltsville, Md.

For the Bureau of Entomology and Plant Quarantine, plans for a ventilation system for the fumigating house at Laredo, Tex.

For the Office of the Secretary, plans for a sewer system and for water and power service lines at Beltsville, Md.

For the Bureau of Plant Industry, plans for a group of cottages and small buildings at Elsberry, Mo.; storage facilities at Ames, Iowa; a cotton-breeding storage plant at Stoneville, Miss.; a cottage, sewerage, electric service, a laboratory, and other equipment at Meridian, Miss.; a group of small buildings at Statesville, N. C.; a laboratory and cotton-ginning plant at Knoxville, Tenn.; and a laboratory at Beltsville, Md.

For the Soil Conservation Service, plans for cottages at Elsberry, Mo.

For the Bureau of Public Roads, preliminary studies for a group of testing laboratories at Arlington, Va.















# REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
Washington, D. C., September 14, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Animal Industry for the fiscal year ended June 30, 1935.

Sincerely yours,

J. R. MOHLER,  
*Chief.*

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## ACTIVITIES OF NOTEWORTHY PROMINENCE

The work of the Bureau of Animal Industry dealt, during the last year as formerly, with the prevention, control, and eradication of animal diseases and parasites, the enforcement of Federal livestock laws and regulations, inspection work, and research. None of the more serious diseases prevalent in various parts of the world but not existing in the United States gained access to this country. Consequently, it has continued to be free from foot-and-mouth disease, rinderpest, contagious pleuropneumonia, surra, and other dreaded diseases that exact heavy tribute in many foreign countries.

In dealing with maladies present in the United States, the Bureau has concentrated its efforts on several major activities of wide public interest, notably the suppression of tuberculosis and Bang's disease. At the same time it continued its usual regulatory and research functions as well as engaging in several new projects.

### TUBERCULOSIS ERADICATION

The extensive Federal-State project for eradicating bovine tuberculosis, now in its eighteenth year, made exceptional progress largely through the aid of additional Federal funds made available in connection with agricultural adjustment and emergency programs.

Considerably more than 25,000,000 tuberculin tests were applied with the result that the area officially recognized as practically free of bovine tuberculosis was greatly extended. More than 600 counties were placed in the so-called "modified accredited area" during the year, making a total of approximately 79 percent of all counties in the United States being so recognized. In other respects also tuberculosis eradication made greater progress than in any previous year. The present estimated prevalence of this disease in the United States is 0.6 percent as compared with 4 percent early in the eradication campaign.

### BANG'S DISEASE

Also with the aid of emergency funds the Bureau has now completed the first year of an active field campaign, in cooperation with the States, against Bang's disease. This work, voluntary on the part of cattle owners, has gone forward rapidly in practically all the States. Indemnity for cattle removed

because of their reaction to the test for Bang's disease is provided in a manner similar to the payment of indemnity for tuberculosis.

Somewhat more than 3,300,000 cattle were tested for Bang's disease, of which approximately 13 percent reacted. It is noteworthy that the total number of Bang's disease reactors exceeded the total number of reactors in the campaign against bovine tuberculosis.

Though conducted primarily on an individual-herd basis, this activity, near the end of the year, was going forward in several districts under a system of county-wide testing. Thus the development of Bang's disease work on an area basis appears to be following the same successful course as that of tuberculosis eradication.

#### FEDERAL MEAT INSPECTION

As in previous years, the operations of the Federal meat-inspection service continued to be conducted on a large scale. Bureau employees engaged in this work inspected more than 72,000,000 animals before and at the time of slaughter. Federal supervision also covered the curing, canning, and other handling of more than 7,000,000,000 pounds of meat and meat food products. In addition to this regular work, Bureau employees conducted special inspection for other branches of the Government, including the supervision of large quantities of meat for relief purposes.

#### ANIMAL-HUSBANDRY INVESTIGATIONS

Besides conducting fundamental research dealing with numerous livestock-production studies, investigators of the Bureau aided in the general development of the Beltsville Research Center, Beltsville, Md. Animal-husbandry work constitutes a large proportion of the activities of this outstanding institution. Record-of-performance studies and allied investigations in genetics have continued to show the desirability of developing superior strains within breeds largely through the selection of breeding stock having offspring of noteworthy excellence. This type of investigation gives promise of providing means for materially improving the breeding and utility value of livestock in the United States.

Many technical developments likewise have resulted from research. A rapid improved method of making cross sections of animal fibers and studying them microscopically is especially noteworthy for its practical application in animal breeding and the textile trade.

During the year the Bureau aided in the development of a national plan for the improvement of poultry with special regard to the quality of baby chicks and the elimination of pullorum disease from breeding flocks. The Bureau's participation in this plan has been largely in support of the general objectives and in bringing about uniformity of standards among the States. Details of administration are under the supervision of State poultry officials.

#### INTERNATIONAL VETERINARY CONGRESS

The year covered by this report was noteworthy as being the first time that the International Veterinary Congress met in the United States. This organization, now 72 years old, has exerted a beneficial influence on veterinary research and the livestock and related industries. During the period of the congress, August 13 to 18, 1934, members of the Bureau's scientific staff presented six papers on veterinary topics of international interest. These are included in the printed proceedings of the congress, published in three volumes. In addition, Bureau employees participated in discussions and otherwise took an active part in the affairs of the organization. After the congress a large delegation of foreign veterinarians visited the Bureau's laboratories and experiment stations in and near Washington, D. C. These contacts with foreign officials, in addition to similar consultations during previous veterinary congresses, have been helpful in official work and beneficial to industries of this country. Such cordial relationships have established a better understanding of livestock conditions and veterinary procedures throughout the world. Results of research are also more fully shared and regulatory work is conducted in a manner that provides greater security from disease with minimum inconvenience to commerce and industry.



### PERSONNEL

Since last year's report the Bureau has sustained a serious loss in the death of several outstanding research workers and in the retirement of others. Marion Dorset, chief of the Biochemic Division for more than 30 years, died July 14, 1935, after a short illness. Though known especially for the discovery and improvement of anti-hog-cholera serum, Dr. Dorset made many other contributions to pure and applied science and to the public welfare. On July 28, shortly after Dr. Dorset's death, James A. Emery, another outstanding scientist and acting chief of the same division, also died.

In addition, the Bureau sustained the loss, through retirement on January 1, 1935, of R. P. Steddom, chief of the Meat Inspection Division since its beginning. On July 31, C. C. Carroll, for many years administrative officer, also retired. Other noteworthy losses have occurred in the Bureau's field organization. This natural condition, however, is being met by the advancement of other employees, transfers and new appointments. The Bureau welcomes its many well-qualified and public-spirited new appointees.

At the beginning of the fiscal year the Bureau rolls showed 4,804 regular employees of all grades and designations in Washington, D. C., and in the field. During the fiscal year, 1,125 were added to the rolls, 1,106 by appointment or reappointment, 11 by transfer from other bureaus or departments, and 8 by reinstatement. During the same period 67 employees resigned, 33 died, 16 were transferred to other bureaus or departments, 13 were removed for cause, and 70 were retired under the amended Retirement Act of May 29, 1930. Other separations, principally of agents, unskilled laborers, and seasonal and temporary employees, numbered 1,692, making the total separations for the fiscal year 1,891. On June 30, 1935 the Bureau rolls carried 4,038 regular employees, a net decrease during the year of 766.

In addition there were, at the beginning of the fiscal year, 680 temporary employees of various grades and designations serving in emergency activities, such as the cattle-reduction plan, the eradication of bovine tuberculosis under the provisions of the Jones-Connally Act, and the program of the Public Works Administration. During the fiscal year there was a great increase in the number of temporary employees, practically all of whom were assigned to the campaigns to eradicate bovine tuberculosis and Bang's disease. The total was 3,780.

The combined number of regular employees and emergency temporary employees at the end of the fiscal year was 7,818.

### VETERINARY EDUCATION

During the year 360 students graduated from accredited veterinary colleges, an increase of 82 compared with the preceding year. The total enrollment was 1,892 students, an increase of 387 over the number enrolled during the preceding year.

There are 10 accredited veterinary colleges in the United States, the number being unchanged from last year. The number of foreign recognized veterinary institutions also remains unchanged at 13.

### PUBLICATIONS AND EXHIBITS

Publications prepared by the Bureau and printed by the Government during the year included 50 new and revised documents. These dealt with the production and care of livestock, results of research, and administrative activities. In addition, Bureau employees contributed 229 manuscripts on various phases of livestock work and research to periodicals published outside the Department.

As in the past, the Bureau furnished the Press Service and Radio Service of the Department with numerous articles and material for broadcasting on activities of public interest. Bureau employees also participated in radio broadcasts from Washington, D. C., and field stations.

In cooperation with the Department's Division of Exhibits, the Bureau furnished subject matter for 5 new exhibits and the revision of 15 others. In addition, it participated in the preparation and revision of numerous charts, maps, lantern slides, and other pictorial material for which there is extensive public demand. Such material was shown and discussed by employees at 39 expositions, fairs, and conventions, in addition to being lent for numerous other purposes.

The work of the various divisions of the Bureau is presented more fully in the following pages:

### ANIMAL HUSBANDRY DIVISION

The work of the Animal Husbandry Division, consisting chiefly of research in animal husbandry, including poultry husbandry, was conducted under the direction of E. W. Sheets, chief, until October 21, 1934; of D. A. Spencer, acting chief, from October 22 to December 31, 1934, inclusive; and of Hugh C. McPhee, chief, thereafter.

During the year the Division continued to cooperate, through three extension representatives, with the Extension Service and State extension workers in the establishment and furtherance of livestock projects.

#### ANIMAL GENETICS

Two inbred strains were maintained in Chester White swine. Brother-sister matings in the most advanced strain have now reached the seventh generation. During the last three farrowing seasons litter size averaged 9 pigs in the third generation, 8.8 in the fifth, 5 in the sixth, and 6.25 in the seventh, 8.8 in the outcrosses of noninbred boars on fourth-generation inbred sows, 9.5 in crosses between strains, and 7.9 in all the crosses made among the various generations of the most advanced inbred strain.

Fed under record-of-performance conditions from 72 days of age to the time that individual weights of approximately 225 pounds were reached, inbred litters at Beltsville showed noteworthy variations in average daily gains and feed consumption. Average daily gains ranged from 1.05 to 1.50 pounds and feed consumption, per 100 pounds of gain, from 348.6 to 409.8 pounds.

The pigs of both the sixth and seventh generations had less vigor than those of the fifth generation, as indicated by smaller size of litter and smaller birth and weaning weights. There was a higher mortality between birth and weaning for all inbred pigs than for the outcrosses, the crosses between lines, or the crosses among the various generations within the strain. The time required for the pigs of the sixth generation to reach the final weight of approximately 225 pounds was 10 percent longer than for those of the fifth generation. Final feed-lot data have not yet been obtained for the seventh-generation pigs.

An anatomical study of inbred strains of guinea pigs differing genetically in various respects, such as fecundity, rate of growth, and body size, has brought to light facts concerning the weights of organs, glands, and body parts. Regardless of breeding group, differences invariably exist among the various organs and glands. Lungs, thyroid, spleen, and suprarenals are consistently variable in weight. Weights of hind and front quarters, eyes, and kidneys, and length of intestine are low in variability. One inbred family was outstanding in that it showed less variability than the others in various respects. Among the various breeding groups definite differences exist with respect to live weight and mean weight of many of the organs and glands. When the weights of these organs and glands are expressed on a percentage of live-weight basis, however, there are very few differences among breeding groups in these respects. It is apparent that these breeding groups, which have been so closely inbred that they are theoretically homozygous in all genetic characters, differ only in general-size factors and not with respect to special genes affecting the organs or proportional body parts. The only exceptions to this general conclusion are the shape of the spleen and the weight of suprarenal glands. It was observed that these characteristics differed materially among the inbred animals.

Several general observations, the genetic significance of which is not clear at the present time, were made. Percentage of calcium and phosphorus in the blood showed considerable variation among individual animals, but relatively small average variation among breeding groups. The same was true of catalase content of the blood. There was relatively little variation in both length and weight of bone in front and hind quarters, but there was a distinct tendency toward a higher percentage of bone in the animals from breeding groups with genetically lower mature weight. The cytological analyses of pituitary glands showed considerable variation in the percentage of various cell types in the different breeding groups, but a statistical analysis of the data indicated that such variations are associated with age rather than genetic constitution. As age increases there is an increase in the number of colloid droplets present and the percentage of basophile cells decreases.



This study has brought out several points of fundamental importance to the breeding program for the improvement of larger animals. First it shows that the situation in regard to the type of characters dealt with is exceedingly complex and involves the effect of large numbers of genes on the organism as a whole rather than specific effects of single genes on characters of minor economic value, such as color. Although the animals used as material were from strains inbred for a sufficient number of generations, 25 or more, to be theoretically homozygous in all genetic factors, they were developed by a system of brother-sister matings without selection, and this fact may account for the small number of differences observed among the various inbred groups.

### ANIMAL NUTRITION

Studies on the composition of the butterfat of goat's milk showed a much greater complexity than earlier analyses as regards the number and distribution of the component fatty acids, and were in agreement with recent work on the butterfat of cow's milk.

In experiments on the influence of food intake on growth and development, rats were fed diets in which the protein intake was held constant and the energy, in terms of calories, varied, and vice versa. The protein consisted entirely of a meat meal made exclusively of muscle tissue. The maximum growth of 100-gram rats fed through a 56-day period was obtained on a daily diet containing 48 calories and either 3 or 4 g of protein. The level at which the protein became the limiting factor decreased with the daily calorie intake until only maintenance of body weight resulted at a 24-calorie and a 1-g protein intake daily. A drop in fat content occurred when the calorie intake was less than 40 per day.

Hogs were fed at three levels of protein intake with the total daily ration restricted to 3 percent of body weight. During the growth period from approximately 65 to 200 pounds, the rate of gain and the efficiency of feed utilization increased with increasing protein content of the diet up to the maximum fed, approximately 19 percent. On the highest protein level, gains were greater during the first half of the growth period. No differences were noted in firmness of carcass, in market grade, nor in fatness as judged by the percentage of fat cuts or thickness of back fat.

In connection with vitamin A assays upon animal products as affected by the diet of the animal, use has been made of a prophylactic feeding plan with rats. The products have been assayed in comparison with the international and the U. S. P. standards. The advantage of the prophylactic as compared with the therapeutic method apparently is a more direct and more reliable growth response in the animal as a measure of vitamin A.

### MEAT INVESTIGATIONS

Meat investigations were continued in cooperation with the Bureaus of Agricultural Economics and Home Economics and eight State experiment stations.

Carcass studies of 155 hogs showed length of carcass, from first rib to aitch bone, to be a good index of dressing percentage and cutting yields. The hogs were divided into three groups—short, intermediate, and long—on the basis of carcass length. In these groups, the average lengths were 30.1, 31.4, and 32.7 inches, and average final feed-lot weights were 222, 222, and 224 pounds, ranging from 215 to 234 pounds. The average dressing percentages for the three groups were 74.9, 75.6, and 75.8. The hogs of the long-bodied group yielded the highest percentages of the leaner cuts, including ham, loin, picnic shoulder, and shoulder butt, and of sausage, and also of the cuts containing the higher proportion of bone, including spareribs, shoulder ribs, and feet. The short-bodied hogs were fatter than the longer hogs and yielded the highest percentages of the fatter cuts, including bacon, leaf fat, and cutting fat.

Data on 831 hogs varying widely in type, breeding, age, weight, and degree of finish showed an interesting relation between type of hog and plumpness or development of ham. Just prior to slaughter each hog was judged for type and for plumpness of ham and other characteristics by a committee of three. In addition, certain measurements were taken on each chilled carcass, including ham circumference and length. The ratio between the two ham measurements was used as an index of plumpness. In general, as type changed from large to small there was an attendant increase in the plumpness of the hams, as indicated both by the index and committee judgment. For example, the hogs

of small-plus type showed about 27 percent more plumpness of ham than those of large-plus type, according to the index.

Ham plumpness, as measured by the above-mentioned index, was found to be associated with the proportion of separable fat of the ham. In this study 140 hogs were used which varied widely in type and breeding but ranged only from 215 to 234 pounds in final feed-lot weight. Even closer relationship was found between the percentage of total edible meat, including both lean and fat, and plumpness.

Studies were inaugurated during the year on the carcasses and meat from hogs of Danish Landrace and Danish Yorkshire breeding. The limited data showed the Landrace and Yorkshire hogs, among other differences, to be longer in body and better developed in ham than the average of 510 well-bred hogs of breeds commonly raised in the United States and slaughtered at a similar weight at Beltsville, Md., in recent years. For example, 4 hogs slaughtered from one Landrace litter averaged 1.2 inches longer in body from first rib to aitch bone and had about 25 percent greater plumpness of ham, in contrast to the previous observation that, for breeds in general, small-type hogs have the plumper hams.

A biometrical study of the carcasses of 831 hogs which varied widely in breeding, type, age, finish, and other characteristics showed a closer relation between average width of carcass, through hams and shoulders, and depth of carcass at the seventh dorsal vertebra, than between average width of carcass and its length from the first rib to the aitch bone, or between depth and length. The results support the general observation that in the growth of the hog the widening and deepening of the body are closely associated and neither of them as closely accompanies the development of length of body. They also suggest that in swine-improvement work there would be a rather definite tendency for any increase in proportionate width to be accompanied closely by an increase in depth, or vice versa, but that there would not be this close association between width or depth and length.

Comparison was made of fresh skim milk, dried skim milk, and tankage as protein supplements in fattening-hog rations, which consisted otherwise of barley 2 parts, corn 1 part, wheat 1 part, and minerals, to study principally their relative influence on the palatability factors of the meat. The proportion of protein was practically the same in the three rations. The hogs were slaughtered when they individually reached the final feed-lot weight of approximately 225 pounds. Standard loin samples were roasted and graded for palatability. In general the pork from the hogs fed the fresh skim-milk ration was superior in palatability to the pork from the hogs fed the dried skim milk and tankage rations. Differences were small but the trend was so consistent, including the factors of tenderness, intensity and desirability of flavor of lean, desirability of flavor of fat, and richness of juice, that further work seems well justified to establish more definitely the possibilities of fresh skim milk in the production of high-quality pork.

In beef studies, the percentage of bone in the ninth, tenth, and eleventh rib cut, which is used as a standard carcass sample, was found to be closely related to the percentage of bone in the entire beef carcass. An equation by which the percentage of bone in the carcass can be estimated in a given case was developed as follows:  $\text{Percentage of bone in carcass} = 4.296 + 0.612 \times \text{percentage of bone in ninth, tenth, and eleventh rib cut}$ . It is expected that this method will prove useful to research workers and others who have need to estimate the bone content of beef carcasses rapidly and with little expense. Data from 84 steers and 36 heifers, varying from about 10 to 20 months of age at time of slaughter and in breeding, feeding, weight, degree of finish, and other characteristics, were used in these studies.

In lamb-carcass studies slaughter-animal and carcass grades were found to be rather closely associated with the firmness of fat.

Lamb curing and aging studies were continued with varying results. A sweet pickle with a salinometer reading of 75°, made of 6 pounds of salt, 3 pounds of brown sugar, 3 ounces of saltpeter, and water, was used at a temperature of about 38° F. All cuts were then smoked for a uniform period. Loins cured for 20 days in this pickle were judged to be too salty and of poor quality, especially with reference to flavor of fat, when boiled 21 days after removal from cure. Legs weighing up to 6 pounds, cured for 29 days, were judged as palatable though slightly too salty after 11 days' storage; and unsatisfactory after 89 days' storage, due to excess saltiness and to rancidity. Legs weighing more than 6 pounds, cured for 45 days, and boiled 7 days



after removal from cure were judged more palatable than the lighter weight legs. After 105 days' storage these heavier legs had decreased in palatability, though they were still superior to the lighter legs. The salt content of the cuts ranged from about 8 to 10 percent as they came from the smokehouse and from 10 to 12 percent as they came from storage.

The intensity of flavor of samples of various commercial lards and other shortenings was found to rank as follows, from the most intense to the least intense: An oleo stearin and cottonseed-oil compound, prime steam lard, dry-rendered lard, hydrogenated cottonseed oil, kettle-rendered lard, and hydrogenated lard.

Samples of lean from carcasses of hogs receiving a submaintenance ration of corn silage and clover hay were judged to be less desirable in flavor than those from hogs full fed on a good ration. It is of special interest that the judges recorded less difference in desirability of flavor when blindfolded than when they were permitted to see the meat samples.

The acuteness of taste of judges in the meat studies was tested by varying concentrations of certain chemicals and food substances for the purpose of identifying judges whose taste reactions to saltiness, sweetness, bitterness, and sourness are similar and most likely to be those of the average consumer.

## BEEF AND DUAL-PURPOSE CATTLE INVESTIGATIONS

### BREEDING INVESTIGATIONS

In record-of-performance studies with beef and dual-purpose cattle at the Beltsville Research Center, 12 beef calves (10 steers and 2 heifers) were weaned at 252 days of age, fattened on corn and alfalfa hay, and slaughtered when they had attained 900 pounds live weight. As in previous years, the results showed wide variations among individual animals. The average time required from birth to attain 900 pounds weight was 468 days. The daily gains per head from weaning to slaughter averaged 1.41 pounds. The digestible nutrients required for each 100 pounds of gain from weaning to slaughter average 668 pounds. The average fattening period was 216 days.

Records of the performance of 35 beef calves (13 steers, 16 heifers, and 6 bulls) from birth to weaning at 252 days showed that the heaviest calves at birth required the least feed per 100 pounds of gain up to weaning time. The feed requirements per 100 pounds of gain from weaning to slaughter weight were greatest with the calves that were heaviest at birth and at weaning time.

Twenty-seven head of Milking Shorthorn steers receiving whole milk, hand-fed or nursed, with grain and alfalfa, were weaned at 252 days of age and then fattened and slaughtered at 900 pounds. The average time required for a steer to attain a weight of 900 pounds was 495 days. The daily gains for the 27 head from weaning to slaughter averaged 1.53 pounds. The average number of days required for the fattening was 243.

In breeding experiments at the Chinsegut Hill Sanctuary, Brooksville, Fla., calves from purebred Red Polled cows averaged 67 pounds at birth as compared with 61 pounds for grade (Red Polled  $\times$  native) calves and 53 pounds for natives.

In crossbreeding experiments at the Iberia Livestock Experiment Farm, Jeanerette, La., in cooperation with the Louisiana Agricultural Experiment Station, in which Aberdeen-Angus cows have been bred to Guzerat bulls, the first generation of crossbreds have greater size and weight for age than purebreds. The polled characteristic is dominant in about 30 percent of the first-cross heifers and in less than 5 percent of the first-cross bulls. However, all the offspring from such heifers bred back to the Aberdeen-Angus bulls have so far been polled. The black color of the Angus appears to be dominant.

### FEEDING INVESTIGATIONS

At the United States Range Livestock Experiment Station, Miles City, Mont., a plane-of-nutrition experiment was terminated August 7, 1934, covering a period of 952 days. In this experiment steers born in 1931 were carried in three groups, through winter seasons, as calves, yearlings, and 2-year-olds on high, medium, and low planes of feeding. The results indicate greater economy of production when steers were carried on medium-to-low planes of feeding, in which a greater proportion of the total gain in weight of steers was made on native range. Steers on the low plane of feeding, with a feed and range cost

of \$1.13 per 100 pounds of gain, averaged only 39.3 pounds lighter in weight than the steers on the high plane of feeding, with a feed and range cost of \$3.41 per 100 pounds of gain.

Three years of tests have been made at Grain Valley, Mo., in which fall calves were creep-fed, previous to weaning, on a mixture of 8 parts shelled corn and 1 part cottonseed meal by weight, with and without 1 part of a molasses feed. These tests showed that the addition of about one-half pound of a molasses-feed mixture to the ration increased the sales value of the calves at weaning time but not sufficiently to offset the increased cost of gains. The addition of molasses increased the appetite of the calves somewhat. The comparison was carried through the fattening period with the conclusion that the relative prices of corn and molasses feed will determine whether the addition of molasses is advisable for replacing a portion of the corn in the ration. In the first year, with corn valued at 43 cents a bushel and molasses feed at \$22 a ton, the feed cost per 100 pounds of gain was 70 cents less for the nonmolasses-fed group, but with corn at 70 cents a bushel and molasses feed remaining at \$22 a ton, during the second year's test, the addition of the molasses feed resulted in \$1.29 lower cost of 100 pounds of gain.

The first year's detailed steer-feeding investigation in cooperation with the Bureau of Plant Industry and the Texas Agricultural Experiment Station was completed at Big Spring, Tex. Twenty steers were fed individually and 20 as a group on ground milo heads, cottonseed meal, and Sumac sorghum fodder for 180 days. Yearling steers fed individually made an average total gain of 388.3 pounds as compared with 427.7 as the average for the group-fed steers. The difference of 39.4 in gain per head is significant. In feed requirements per 100 pounds of gain in weight, the individually fed steers consumed on the average 489.2 pounds of digestible nutrients as compared with 527.7 pounds by the group-fed steers. The difference of 38.5 pounds is significant and is possibly accounted for by the observation that more exercise was taken by the group-fed steers. Each individually fed steer was confined in a pen 5 by 40 feet in size, whereas the group-fed steers had access to the same total area of ground.

In steer-feeding experiments in cooperation with the Texas Agricultural Experiment Station at Spur, Tex., well-developed steer calves were wintered on threshed white kafir grain, cottonseed meal, and cottonseed hulls for the purpose of determining whether this ration is deficient in either vitamin A or lime. Control groups were fed similar rations except that a portion of the concentrates and cottonseed hulls was replaced by leafy alfalfa hay. The first indication of a supposed vitamin A deficiency was observed after the calves had been on feed 116 days. Each of the 10 calves receiving kafir grain, cottonseed meal, and cottonseed hulls showed this deficiency within 177 days. Cod-liver oil in varying quantities is being supplied to several of the affected steers, and they have apparently overcome the deficiency. Cod-liver oil from which vitamin A was removed has been supplied to several steers without beneficial results. Alfalfa in varying quantities is being supplied to several steers to determine the amount necessary to overcome this deficiency. Carotene is also being administered to several steers to determine whether this source of vitamin A can be effectively used for the same purpose. The group of steers receiving as little as 1 pound of alfalfa has not shown any indication of a deficiency of vitamin A. There has been no indication of beneficial results from the inclusion of 0.1 pound of pulverized oyster shell per head daily, as a source of lime, in a ration consisting of ground threshed white kafir, cottonseed meal, and cottonseed hulls.

#### MANAGEMENT INVESTIGATIONS

At the McNeill (Miss.) Experiment Station, in cooperation with the Bureau of Plant Industry, the Forest Service, and the Mississippi Agricultural Experiment Station, the effects of grass fires on the soil and on growth of forage were studied. Analyses of the soil of virgin longleaf pineland to the depth of plant-root growth, after 8 years of burning and nonburning, showed that an area burned annually was about one and one-half times as rich in organic matter and nitrogen as a similar area not burned. Increased growth of grasses and legumes occurred on the burned areas.

During 1933 and 1934 grazing studies with cows and calves were conducted in cooperation with the Forest Service to test three intensities of grazing at the United States Range Livestock Experiment Station, Miles City, Mont. On overgrazed range, stocked at the rate of 1 cow to 23.1 acres for a year, calves weighed 68 pounds at birth and 263 pounds at weaning time. On moderately grazed



range, stocked at the rate of 1 cow to 30.5 acres, calves had a birth weight of 75 pounds and a weaning weight of 301 pounds. On lightly grazed range, stocked at the rate of 1 cow to 38.8 acres, calves averaged 71.5 pounds at birth and 309 pounds when weaned. The pounds of calf produced per cow were 198, 278, and 240, respectively, for the overgrazed, moderately grazed, and lightly grazed ranges. The respective costs, per pound, of producing calves under the three intensities of grazing were 3.84, 2.44, and 2.83 cents.

In the management of beef herds for calf production, experiments at Lewisburg, W. Va., conducted in cooperation with the West Virginia Agricultural Experiment Station, showed that spring calves, produced on highly productive farming land, and creep fed previous to weaning, returned \$26.88 for the keep of the cow after the cost of supplemental feed had been deducted. Similar calves, not creep fed, placed in the dry lot in November, and fattened until March 1, returned \$32.66 per calf. Calves produced on mountainous pasture land had a value of \$25.02 per calf as feeders at weaning time in November. These data, as well as those of the preceding year, indicate that the fattening of calves, either on supplemental feeds previous to weaning or by feeding in the dry lot immediately after weaning, can be made a profitable business, under conditions such as existed in 1933 and 1934. On highly productive farm land in the Appalachian region such an enterprise appears to be more profitable than the production of feeder calves on the mountainous areas.

Pasture management and grazing studies at the Georgia Coastal Plain Experiment Station in cooperation with the Bureau of Plant Industry show that a mixture of carpet grass, Dallis grass, lespedeza, and white clover is a satisfactory lowland permanent pasture. The results of fertilizer experiments with this combination of plantings indicate that the lowland pastures of the Coastal Plain area need an application of phosphorus. When a complete fertilizer was applied at the rate of 600 pounds an acre, a gain of 298 pounds of beef was made per acre as compared with 91 pounds of gain on a pasture of carpet grass and lespedeza when no fertilizer was used. In the case of upland permanent pastures Bermuda grass and lespedeza continue to give much better yields than centipede grass and lespedeza. The centipede-grass pasture has been divided. One area was fertilized. The fertilized area is maintaining the animals much better than the unfertilized area.

Six years of pasture management and utilization studies in cooperation with the Bureau of Plant Industry have been completed at the Beltsville Research Center, Beltsville, Md. The length of the grazing season averaged 154 days for the 6 years with a range of 112 to 168 days. One group of 4 head of steers grazed a pasture of 8 acres continuously, another group of 5 head grazed a pasture of 5 acres continuously, and a third lot of 4 head grazed a pasture of 4 acres, divided into 2 fields of 2 acres each, and alternately grazed. There was no significant difference between the results of alternate heavy grazing and of continuous heavy grazing. The continuous light grazing gave a smaller yield per acre, but the cattle were usually in better finish at the end of the grazing season.

At the Ardmore Field Station, Ardmore, S. Dak., 2-year-old steers grazed continuously on native range stocked at the rate of one steer to 10 acres from May 15 to September 14 (122 days), gained 83 pounds per steer as compared with 157 pounds gained by similar steers on alternate grazing but at the same rate of stocking. Steers receiving a barley supplement of 9.57 pounds per head daily on similar range gained 297 pounds per head, and an additional group fed a barley supplement of 9.8 pounds per head daily for the last 66 days on grass gained 227 pounds per head. It was estimated that from 10 to 15 percent more grass remained at the end of the experiment when the area was grazed alternately than when it was grazed continuously.

#### BEEF AND VEAL STUDIES

In connection with the record-of-performance studies at Beltsville, Md., 12 beef calves slaughtered at 900 pounds of live weight graded, on the average, low Choice as feeders and top Good as slaughter calves and in carcass. The quantity of cold dressed beef produced per 100 pounds of digestible nutrients fed averaged 17.1 pounds and ranged from 13.9 to 21.9 pounds. The data indicate a close association between weaning weight and pounds of dressed beef per given quantity of feed, as the latter was consistently higher in the case of the calves having the heavier weaning weights.

Twenty-seven Milking Shorthorn steers slaughtered at Beltsville, Md., at 900 pounds of live weight graded low Good as feeders, on the average, and the top of Medium at slaughter and in the carcass. For every 100 pounds of total digestible nutrients consumed, 15.1 pounds of cold dressed beef was produced on the average, with a range of 10.46 to 18.7 pounds.

#### SHEEP, GOAT, AND ANIMAL-FIBER INVESTIGATIONS

Sheep, goat, and animal-fiber investigations were conducted at 18 Federal and State experiment stations.

##### FARM-SHEEP INVESTIGATIONS

At the Beltsville Research Center a study of various temporary pastures for sheep showed that lespedeza can be utilized to advantage in combination with mixed grasses in order to produce the maximum amount of pasture. This fact is due to the tendency of the crop to grow best in the hot summer months, when other grasses under usual conditions dry up. An average of 74.2 percent more sheep-days of grazing per acre were obtained from this pasture mixture than from a pure lespedeza pasture. Mixed seedings of cereal crops continue to yield more pasture for sheep than any one sown alone.

Data obtained at Beltsville on live weights of lambs of various breeds at the age of 140 days show that Hampshires produced an average of 81.1 pounds of lambs per ewe as compared with 66.0 pounds for Corriedales, 58.8 for Shropshires, and 59.0 for Southdowns. A comparison was made of the live-lamb weight of the leading family with the average of the entire flock for each of these breeds. Hampshire family no. 1 produced 7.3 pounds more lambs than the average for the entire flock. Corriedale family no. 1 produced 5.5 pounds more, Shropshire family no. 1 produced 10.4 pounds more, and Southdown family no. 1 produced 9.6 pounds more than the average for the flock. Similar advantages to these families were found when the market grades of the lambs were compared. These data emphasize the advantages in the productivity of certain families or strains of sheep over others that may be very similar in appearance.

A preliminary feeding test was conducted with 16 lambs to determine whether tankage is satisfactory to use in a mixed grain ration for fattening lambs. This test was of 84 days' duration. Eight lambs were fed tankage that contained 60 percent protein. The other eight received an equal quantity of old-process linseed meal. The daily ration per lamb averaged approximately 2 pounds of alfalfa hay, 1 of dried beet pulp, and 0.75 pound of a grain mixture that averaged 42.5 percent of corn, 42.5 percent of oats, and 15 percent of protein concentrate. The average gain of the lambs fed tankage was 26.7 pounds and of those fed linseed meal 21.1 pounds. The 5.6 pounds greater gain per lamb for those fed tankage would mean an advantage of 28 cents per lamb with lambs selling at 5 cents a pound. Although this test is a preliminary one it reveals beyond doubt that tankage is a valuable feed for fattening lambs.

At the United States Morgan Horse Farm, Middlebury, Vt., lambs sired by Southdown rams and from ewes of the Corriedale breed and the cross between the Dorset and the Tasmanian Merino breeds were more satisfactory as hot-house lambs than purebred Dorset and Dorset  $\times$  Tasmanian Merino Crossbred lambs. In percentage of lambs produced, the Dorset  $\times$  Tasmanian Merino crossbred ewes ranked first and were followed by purebred Tasmanian Merinos, Corriedales, and Dorsets. The results obtained indicate that some inheritance of fine-wool sheep in the ewe stock is essential to get lambing percentages large enough to make specialized hothouse-lamb production profitable. Southdown rams seem to have special merit for the siring of lambs of the superior quality demanded by the specialized trade.

##### RANGE-SHEEP INVESTIGATIONS

At the United States Sheep Experiment Station, Dubois, Idaho, ram lambs sired by individual stud rams of the Rambouillet, Corriedale, and Columbia breeds have been fed to determine the relative rate and economy of gain. A standard ration of whole oats and alfalfa was fed for approximately 110 days. Feed costs were based on average prevailing prices in the locality. The Rambouillet lambs gained at the rate of 0.479 pound daily per head and at a cost of



\$7.72 per 100 pounds of gain, the Corriedales at the rate of 0.416 pound daily per head and at a cost of \$8.35 per 100 pounds of gain, and the Columbias at the rate of 0.490 pound daily per head and at a cost of \$7.77 per 100 pounds of gain. Further analysis of the data showed that there were relatively great differences in the rate and economy of gain of lambs of the same breed sired by different stud rams. The trials point to the possibility of establishing strains within a breed that possess the ability to make maximum gains with minimum feed consumption.

Hampshire and Suffolk rams were mated with Rambouillet and Corriedale ewes to test the relative suitability of the rams of these two breeds as sires of market lambs. First-year results showed a slightly larger Hampshire-sired lamb crop, but the Suffolk-sired lambs made greater daily gains after birth and were more than 4 pounds per head heavier at weaning. Ewes bred to Hampshire rams weaned 54.7 pounds of lamb per ewe bred, whereas ewes bred to Suffolk rams weaned 57.6 pounds of lamb per ewe bred. The Hampshire-sired lot of lambs carried slightly more finish at the market, but the Suffolk-sired lambs brought slightly higher prices per hundredweight.

Experience at the United States Range Livestock Experiment Station, Miles City, Mont., with the wintering of ewe lambs in the feed lot for a 90- to 120-day feeding period on an alfalfa-hay and whole-wheat ration has indicated the lack of a balanced mineral diet. To determine whether this condition existed in lambs fed alfalfa hay without grain, 370 ewe lambs were divided, in January 1935, into two lots of equal numbers. One lot was fed alfalfa hay and salt; the other was fed the same quantity of alfalfa hay and bone meal and salt in the ratio of 1 pound of bone meal to 4 pounds of salt. Body weights taken at the beginning and end of an 86-day feeding period indicated no effect resulting from the bone-meal supplement, but the rate of salt consumption of the two lots varied greatly. The lambs fed the bone-meal supplement consumed 120 pounds of salt and 30 pounds of bone meal, whereas the other lot consumed 288 pounds of salt, or nearly twice as much as the mineral mixture.

#### KARAKUL-SHEEP INVESTIGATIONS

At Beltsville, Md., ewes of Karakul  $\times$  Blackfaced Highland and Karakul  $\times$  Corriedale breeding were mated with purebred Karakul rams. The results showed that with each top cross with purebred Karakul rams there is further improvement in the tightness of curl and luster of the lambskins from the offspring. In grading these factors in the lambskins, grade 1 represents the most superior and grade 10 the most inferior. On this basis skins from lambs of the Karakul  $\times$  Blackfaced Highland breeding graded, for tightness of curl, an average of 7.2, 6.0, and 3.0, respectively, for second, third, and fourth top crosses of purebred Karakul sires. For luster the fur from the lambs of this breeding graded, on an average, 4.6, 4.5, and 2.0, respectively, for second, third, and fourth top crosses. The skins from lambs of the Karakul  $\times$  Corriedale breeding graded, for tightness of curl, an average of 7.7, 6.6, and 4.0, and for luster 5.6, 4.8, and 4.0, respectively, for second, third, and fourth top crosses of purebred Karakul rams. The lambskins from purebred Karakuls averaged 5.0 for tightness of curl and 3.6 for luster. These grades for the purebreds are slightly less satisfactory than those for the purebred lambs of last year. This condition is largely accounted for by the extensive use of two young untested sires, which were used in most cases to avoid father-daughter matings in which defects were already apparent. It was thought best to avoid a concentration of blood in these particular cases. These results are based on the evaluation of the tightness of the curl and luster of the fur of 83 lambs recorded within the first 24 hours after birth. Of this number, 34 were purebred Karakuls, 25 Karakul  $\times$  Blackfaced Highland crossbreds, and 24 were Karakul  $\times$  Corriedale crossbreds. Pelts were taken from 40 ram lambs of this crop, and they are being used in special fur studies in cooperation with the Bureau of Biological Survey.

#### STUDIES OF WOOL AND OTHER FIBERS

Tests made on the method of determining the cross sectional variability and fineness of wool developed in the Bureau's animal-fiber laboratory point to the wide practical application of this method. It was applied in a study of Navajo wool to determine the type of present-day native Navajo sheep which are producing wool similar to that used in the hand-weaving of choice old Navajo rugs.

Photomicrographs of cross sections of United States standards for wool top were made. Their fiber fineness and variability were determined and were found to check closely with the results obtained by other investigators.

A study was made of specially selected rams and ewes of the Bureau's sheep to determine the fineness and uniformity of their wool. It was found that the sheep producing the most uniform wool could be readily selected from the photomicrographs of cross sections of their wool, and that by comparing these cross sections with those of United States standards for tops, the fineness of the wool from each sheep in terms of spinning counts could be accurately determined by the eye. Through the use of this method the variations in size and shape of each fiber may be observed and recorded and the merits of wool for different purposes more accurately determined than by methods which do not show cross sections.

Inasmuch as each of the cross sections obtained by this method was about one sixty-fourth inch in thickness, and the method involved the projection of the image of the cross section, the efficacy of the method is largely dependent upon the translucence of fibers, a fact which limits its use for the most part to undyed wool and mohair. In order to make it possible to show clearly the cross sectional details of all fibers, a device was invented by means of which very thin cross sections of fibers may be obtained quickly. Excellent results have been obtained with animal, vegetable, and synthetic fibers. In 10 minutes' time a skillful operator may make cross sections as thin as 0.0001 inch. These very thin sections not only may be used in the same way as the thicker sections but have a much broader application in that they have the added advantage of making it possible to examine quickly the finer structure of animal fibers, such as thickness of cuticle and the size, shape, and distribution of pigment granules, when present. Thin cross sections of vegetable fibers or mixtures of animal and vegetable fibers are a valuable aid in research and are often essential in the identification of the fibers found in yarns of different fabrics.

Tests with side samples, one from each side of the sheep, sheared from an area  $1\frac{1}{4}$  by 4 inches, and weighing approximately 20 grams, showed a high correlation with the clean-wool yield obtained by scouring a 200-g side sample. The use of the small samples has the added advantage of furnishing a measure of the density of the fleece produced by each sheep in terms of weight of clean wool per cubic inch of growing staple.

#### MILK-GOAT INVESTIGATIONS

A compilation of data obtained over a period of years from the Bureau's herd of purebred and high-grade Saanen and Toggenburg milk does at Beltsville showed that body weight, length of lactation, and age of doe are important considerations in milk production. In support of data from other sources studies indicated that does can produce 10 times their average body weight of milk during a single lactation period. This ratio remained much the same regardless of the body weight or breed, indicating that the return per unit of body weight is little influenced by size. The principal advantage, therefore, which the large doe has over the smaller one is the greater total quantity of milk produced.

The length of lactation was a variable factor with different does. In a study of 182 lactations, 18 percent were more than 10 months in length, 24 percent were 10 months, 19 percent 9 months, 17 percent 8 months, and 22 percent less than 8 months in length. The average length of all lactations was 267 days, or approximately 9 months.

The does reached their maximum productivity between 4 and 6 years of age and declined thereafter. The data indicated that a doe as a 2-year-old may be expected to produce about 75 percent, as a 3-year-old 80 percent, and as a 4-year-old about 95 percent of the milk she will produce at 5 years of age, or at her period of maximum productivity.

#### SWINE INVESTIGATIONS

The first litters from the Danish Landrace and Danish Yorkshire hogs, imported in 1934 for experimental studies, were farrowed at Beltsville in the fall of 1934. Seven Landrace sows farrowed an average of 9.1 pigs per litter, whereas three Danish Yorkshire sows farrowed an average of 14.7 pigs per litter. A total of 36 sows of the Chester White, Duroc-Jersey, and Poland



China breeds farrowing fall litters in all other projects averaged 7.2 pigs per litter. The average production of the Danish Yorkshire sows was increased considerably by the record of one sow, which farrowed 21 pigs (20 living and 1 dead). This sow has since farrowed a spring litter, sired by a different boar, of 16 pigs, 14 of which were alive and 2 dead at birth, making 34 living pigs for her first two litters. This sow's pedigree shows an ancestry noted for prolificacy. Her dam farrowed 44 pigs in 3 litters, an average of 14.7 pigs a litter. Her granddams, including the great-granddams, averaged from 11 to 12.8 pigs a litter in a total of 44 litters.

The fall-farrowed pigs from these Danish sows were fed in dry lot under record-of-performance conditions from 72 days of age to individual weights of approximately 225 pounds. The pigs were divided into four lots; one lot contained the Landrace pigs sired by a B-family boar, another lot the pigs sired by an F-family boar, a third lot the pigs of mixed Landrace breeding, and a fourth lot the pigs of Danish Yorkshire breeding. The average daily gains per pig for the different groups varied from 1.37 to 1.53 pounds, and feed consumed per 100 pounds of gain ranged from 342.9 to 374.8 pounds.

A progeny test was conducted with two Chester White boars of different blood lines, bred to sows which were litter mates, for both spring and fall farrow. The sows were unrelated to the boars. The sows bred to boar A for the spring farrow were mated with boar B for the fall farrow, and vice versa. In both average birth weight and weaning weight, the litters sired by the two boars were practically the same. When fed from 72 days of age to a final feed-lot weight of approximately 225 pounds, however, the pigs from boar B were distinctly superior in feed-lot efficiency. In addition, the pigs from boar B required 17 days' less time to reach market weight of 225 pounds. The carcasses showed no material differences.

Studies were continued at Beltsville with small, intermediate, and large-type Poland China hogs. Both line breeding and outbreeding were followed for each of the three types. In all cases, the outbred hogs gained faster and made more economical use of feed than the line-bred hogs in their respective types. Small-type hogs were 270 days of age before they reached 225 pounds of weight, as compared with 236 days for hogs of intermediate type and 228 days for those of large type. Feed consumed per 100 pounds of gain was 389.2, 404.8, and 426.7 pounds, respectively.

Five pairs of Poland China litter mates were hand-fed individually from weaning to final weight of approximately 225 pounds. The pigs were so selected that there was a 1-pound difference in birth weight between the two pigs in each pair. The results indicate a direct relationship between birth weight and the rate and economy of gains. As shown by the average of the five pairs, the heavier pigs made 0.2 pound more daily gain with a saving of 44 pounds of feed per 100 pounds of gain.

Crossbreeding studies were concluded at the United States Range Livestock Experiment Station, Miles City, Mont. Purebred Yorkshire, Duroc-Jersey×Yorkshire, purebred Chester White, Duroc-Jersey×Chester White, Chester White×Duroc-Jersey, and Yorkshire×Duroc-Jersey were included in this year's work. The birth weight of the crossbred pigs averaged 0.24 pound more than that of the purebred pigs. At the close of the feeding test the Chester White×Duroc-Jersey hogs were the heaviest, averaging 231 pounds at an average age of 179 days. The purebred Yorkshire hogs were the lightest, averaging 199 pounds at an average age of 180 days. In the other four groups, there was little difference in the weight at approximately the same age. The purebred Yorkshire pigs made the most economical use of feed, with the Duroc-Jersey×Chester White pigs ranking next. It is noteworthy that the crossbred pigs were about as uniform in weight as the purebred pigs, at approximately the same age. At market the carcasses of the Chester White×Duroc-Jersey and purebred Chester White pigs graded slightly higher than those of the other lots.

Studies on the inherent capacity of strains of swine to utilize feed and produce meat were begun this year at Miles City. Two selected Duroc-Jersey boars, nos. 333 and 310, were mated to two groups of Duroc-Jersey sows, selected especially for uniformity. The pigs sired by boar no. 333 averaged 3.5 pounds more in weight at weaning than those by boar no. 310. Eighty-four days after weaning the pigs from boar no. 333 were well finished and averaged 207 pounds, whereas those from boar no. 310 averaged 174 pounds and were underfinished, "leggy", poorly developed in ham, and not ready for market. With little difference in feed consumed per 100 pounds of gain, the

pigs from boar no. 333 gained 0.3 pound more per day than the others. Also their carcasses graded distinctly higher.

Studies begun at Miles City in 1930 on the birth weight of pigs were continued. Of the live pigs farrowed in the spring of 1934 weighing less than 3 pounds, 75 percent reached weaning age, whereas 92 percent of those weighing more than 3 pounds reached weaning age. The weaning weight, at 70 days, of the pigs weighing less than 3 pounds at birth averaged 43.8 pounds, as compared with 48.5 pounds for those weighing more than 3 pounds at birth. These data are in general agreement with data of previous years.

#### HORSE AND MULE INVESTIGATIONS

Studies to determine the value of milk and milk substitutes in rearing orphan foals indicated that the use of normal horse serum in place of colostrum and adjusted cow's milk in place of mares' milk is a satisfactory and practical method. Foals which did not receive colostrum or colostrum substitutes succumbed readily to infections commonly known among horsemen as "joint ill."

To improve the type of the Morgan for saddle purposes, an experimental outcross has been attempted at the United States Morgan Horse Farm, Middleburg, Vt., with a limited number of individuals. Results have been very satisfactory. The stallion Delmont produced by mating the Morgan stallion Ulysses 7565 with the American saddle mare Ladelle is an outstanding individual and produces a very desirable type when mated with registered Morgan mares. The result of mating Mansfield 7255 (Morgan) with the American saddle mare Glenarrow produced an outstanding stallion foal. Glenarrow is strongly bred in Morgan foundation stock, registered Morgans being found as close as the second and third generations in her pedigree. Judicious outcrossing has received recognition of the Morgan Horse Registry in that certain outcross stallions and mare that produce desirable offspring will be accepted for registry in the Morgan Horse Register.

A second year's comparison at Miles City, Mont., of whole oats and alfalfa hay with alfalfa hay alone for wintering weanling colts showed results agreeing with the first year's work. Light-type weanlings made average daily gains of 1.27 pounds on the former ration compared with 0.83 pound on the latter. Feed consumed per 100 pounds of gain was 386 pounds of oats and 580 pounds of alfalfa hay by the former group, and 1,674 pounds of alfalfa hay by the latter group. Draft-type weanlings wintered on oats and alfalfa hay made average daily gains of 1.98 pounds and consumed 349 pounds of oats and 731 pounds of alfalfa hay per 100 pounds of gain.

#### CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING

Under the provisions of paragraph 1606 of the Tariff Act of 1930, certificates of pure breeding were issued for 274 horses, 8,663 cattle, 1,036 sheep, 12 swine, 839 dogs, and 12 cats. The total number of animals certified during the year was 10,836.

#### POULTRY INVESTIGATIONS

##### POULTRY BREEDING

Experiments were conducted to test the effect of different types of packing on eggs with respect to the development of tremulous air cells. The data indicated that rigid packing produces fewer tremulous air cells in eggs than the loose types of packing even when the eggs are shipped for considerable distances.

The usefulness of a hormone test in determining genotypes in crossbred fowls was demonstrated in the progeny of a Black Sumatra and White Wyandotte cross. Ovariectomy of the female offspring and injections of an aqueous solution of theelin in the males demonstrated that the genetic dimorphism in this cross was determined by gonadal secretions. Whether or not a genetic dimorphism is determined by gonadal secretions or sex-linked genes can be ascertained within a few weeks by using a hormone test without resorting to a breeding test which is more expensive and time consuming.

By the utilization of semen obtained by a recently described method, a new technic for artificial insemination in fowls has been devised which has made it possible to obtain 97-percent fertility. White Silkie Bantam females were inseminated with semen from crossbred males weighing about four times as



much as the females. In natural matings such a difference in size resulted in little or no fertility. Chicks from artificially inseminated matings hatched well.

A statistical study of the inheritance of rate of laying involving approximately 2,400 White Leghorns and 2,200 Rhode Island Reds showed that sires and also dams differ materially in their ability to transmit high rate of laying to their daughters. This finding demonstrated that rate of production is a heritable character.

In egg-quality studies, neither the total quantity nor the percentage of thick albumen was significantly related to hatchability. However, both egg weight and the quantity of total albumen were significantly related to the hatchability of the eggs.

Studies on the brooding of chicks in tents instead of the customary brooder houses show that tents are satisfactory where the climate is subtropical.

#### PHYSIOLOGY AND HATCHABILITY STUDIES

Analyses of 5 years' data on embryo malpositions showed that the study of their incidence is of value chiefly in the diagnosis of causes of low hatchability.

In view of the fact that in poorly ventilated incubators there is a tendency for the carbon dioxide content to be high at the end of the incubation period, a study was made to determine the effect of a high carbon-dioxide content in the air surrounding pipped eggs and eggs which had reached the seventeenth day of incubation. Equal numbers of control eggs were hatched in an incubator for comparison. The effect of carbon dioxide within a range of 5 to 20 percent was studied. With pipped eggs, carbon dioxide concentration up to 15 percent seemed to have no deleterious effect. Between 15 and 20 percent it reduced the hatch about 5 percent. With eggs kept in a high carbon dioxide environment from the seventeenth day of incubation to the time of hatch, 5 percent carbon dioxide produced no ill effect, 10 percent reduced the hatch 40 percent, 15 and 20 percent reduced the hatch 85 percent.

Frozen turkey and domestic-fowl pituitaries and pituitaries from newly hatched chicks and from embryos of 15 days' development were found to stimulate testis growth when they were subcutaneously implanted in the newly hatched male chick.

A disease, of nutritional origin, causing the bones of the embryo to be greatly shortened, was discovered and its incidence in eggs from birds on various diets was studied.

Further studies of the relation between the kind and amount of sunlight available to breeding flocks and the hatchability of their eggs were made. During the winter months hatchability was very low in eggs from birds receiving a diet containing Illini soybean meal as the sole protein supplement. In the spring hatchability increased greatly when this diet was fed. In winter, as well as in spring, hatchability was high when the same diet was supplemented with a special meat meal containing liver.

#### POULTRY FEEDING

A reliable chemical method of determining uric acid in chicken excrement was developed, making possible the accurate determination of the digestibility of the protein of poultry feeds without resorting to surgical alteration of the bird.

A study of the normal development of the leg bones of chickens indicated that the tibia is the most satisfactory bone to use in studying the effect of the various sources of vitamin D on the ash content of the bones of chickens. In using chickens for testing the vitamin D potency of cod-liver oil and similar products, it was found that the length of the test period may be reduced from 8 to 4 weeks without affecting the accuracy of the test.

In a study of the relative value of normal barley, scabbed barley, and yellow corn as the chief ingredient of the feed of laying chickens, it was found that the diets which contained corn were the most efficient. The chickens receiving the corn diets required only about 90 percent as much feed per egg as those receiving the diets containing either normal or scabbed barley.

Earlier observations that excessive quantities of cod-liver oil (more than 4 percent of the total feed consumed) decreased both egg production and hatchability were confirmed. It was found that this effect was due to the

feeding of too much vitamin D, inasmuch as the same result was obtained when relatively large quantities of irradiated ergosterol were fed.

Although rice bran was found to be of value in preventing perosis in growing chicks, it is not entirely satisfactory as an ingredient of the diet of laying hens. The latter tolerate a diet containing rice bran, but do not lay so many eggs as they do when on a similar diet containing wheat bran or wheat middlings.

#### TURKEY INVESTIGATIONS

Experiments with various combinations of feedstuffs for turkeys have been carried on, and suitable formulas have been developed. For starting the poults (up to the age of 8 weeks) the mash should contain between 22 and 28 percent of crude protein and for the rest of the growing period (after the eighth week), 17 to 20 percent. Mineral supplements were found to be unnecessary when sufficient protein to promote normal growth was provided in the form of meat scrap, milk, or fish meal, or a mixture of 2 or 3 of these ingredients.

Turkeys have high vitamin requirements, especially during the first few weeks of their lives. Two percent of standard high-grade cod-liver oil was found to be necessary to insure against vitamin D deficiency in starting feeds. The 2 percent of cod-liver oil also insures against vitamin A deficiency, provided it is mixed fresh. Vitamin G deficiency is guarded against by including from 5 to 6 percent of alfalfa-leaf meal and 10 percent or more of dried milk in the starting mash. Growing turkeys older than 8 weeks can satisfy their vitamin requirements fully if they have access to a green range. Green range tends to reduce feed costs and induces normal behavior. When drought or other factors prevent the turkeys from consuming large quantities of fresh green feed, it is necessary to include 5 percent of alfalfa-leaf meal and 10 percent of dried milk in the growing mash.

The feed requirements of breeding turkeys are not essentially different from those of growing turkeys. Rations that result in good egg production, fertility, and hatchability have been developed. Such rations contain, on the basis of dry-feed intake, about 16 percent of crude protein furnished by meat scraps, dried milk, and fish meal. Vitamins A, D, and G requirements are satisfied in the all-mash laying ration by the inclusion of 4.5 percent alfalfa-leaf meal, 1 percent standard high-grade cod-liver oil, and 4 percent dried milk. Material for eggshell making is provided by using 3.5 percent of ground oyster shell in the all-mash ration in addition to the minerals contained in the other ingredients.

### BIOCHEMIC DIVISION

The Biochemic Division, under M. Dorset, chief, was engaged with work on dips, disinfectants, antiseptics, anthelmintics, certain meat food products, certain biological products for the diagnosis of disease, and with investigations on hog cholera.

#### INVESTIGATIONS OF DIPS, DISINFECTANTS, AND ANTHELMINTICS

Analyses for control purposes were made of 209 samples of dips, disinfectants, and antisepticized products. Inspectors in the field were provided with supplies for making the following tests: 420,960 tests of arsenical dipping baths, 4,800 tests of lime-sulphur dipping baths, 2,520 tests of nicotine dipping baths, and 2,700 tests for control of phenol content of virus or serum. The total number of tests provided for was, therefore, 430,980. Necessary replacements were also provided for apparatus and outfits in use in the field.

Tests were made of the germicidal powers of various dyes against *Staphylococcus aureus*, and against *Bacillus typhosus* and other Gram-negative bacteria. Little power was shown by ethyl violet, light green SF, Bismarck brown, methylene blue, and acid fuchsin. Methyl green showed moderate germicidal power against *S. aureus* but none against Gram-negative bacteria. Crystal violet, brilliant green, and methyl violet showed considerable germicidal power against all the organisms but were more effective against Gram-positive than against Gram-negative bacteria. Crystal violet appeared to excel as an antiseptic, particularly in conjunction with phenol. In defibrinated blood contaminated with micrococci and *B. suis* *typhosus*, the contaminating organisms were killed in 7 days at incubator temperature by a concentration of 0.04-percent crystal violet or by a 0.02-percent concentration when 0.5-percent phenol was also present;



in the refrigerator about 4 weeks was required with a concentration of 0.02-percent crystal violet, but when 0.5-percent phenol was also present the result was obtained in 1 week.

Continued investigation of the germicidal powers of benzylphenol and of chlorinated phenol derivatives indicated the probable practical usefulness of certain substituted phenols as disinfectants against infectious abortion and bovine tuberculosis.

Cooperative work with the Zoological Division on the relationship of chemical constitution to anthelmintic efficiency was continued. Two stable members of a previously untried group of halogenated hydrocarbons were tested: Chlorocyclohexane and bromocyclohexane. Both were found to be of value against hookworms and ascarids in dogs, without harmful effects.

#### MEAT FOOD PRODUCTS

In order to obtain data desired by the Bureau, a survey was made of the methods of dry rendering condemned and inedible products, in use at official establishments in five cities.

Studies, not yet complete, were made of the nutritive value of the proteins of various organs from cattle and swine, together with some tests of vitamin content of such tissues.

#### TUBERCULIN AND MALLEIN

The preparation and distribution of tuberculin and mallein for official use by Bureau and State officials were continued. The year's shipments of tuberculin comprised 3,135,400 cubic centimeters of intradermic tuberculin and 8,280 cc of avian intradermic tuberculin. Subcutaneous tuberculin, as such, is not longer supplied. Inasmuch as that type differed from the present intradermic tuberculin essentially only in that it was one-half as concentrated, intradermic tuberculin, in appropriately reduced dosage, is equally suitable for subcutaneous use.

This year all the intradermic tuberculin was prepared from cultures grown on the synthetic medium discussed in previous reports, with uniformly gratifying results. Through continued improvements in process and equipment it has been possible nearly to double the output of the preceding year at small additional labor cost.

In order to obtain certain information regarding the constitution of tubercle bacilli, feeding experiments were conducted with dried sterilized material obtained by filtering and washing the pellicles from cultures grown on the regular synthetic medium in the routine production of tuberculin. The protein present was found to be of small value, the vitamin G content was very slight, and vitamins A and B were not present.

Mallein supplied during the year amounted to 1,233 cc.

#### STAINED ANTIGEN FOR DIAGNOSIS OF PULLORUM DISEASE

Stained antigen for experimental use, sufficient to make 335,250 tests, was shipped to various State officials. Three additional firms were licensed to manufacture the stained antigen, making a total of 31 firms now preparing this product. Forty-six samples of commercially produced antigen were examined.

Comparative tests by the rapid, whole-blood, stained-antigen method and the tube agglutination method were made on 2 commercial hatchery flocks, comprising 578 chickens, of which 46 yielded a positive reaction. The agreement between the two methods was 98.4 percent. The disagreements were limited to results on "low-titer" blood, 1.2 percent of the chickens being positive to the tube-agglutination test but negative to the stained-antigen test, whereas 0.4 percent showed the reverse relation.

Some progress was made toward eliminating the slight, nonspecific reaction which occurs with an oversensitive antigen. Of 25 substances tested, gum arabic, in the proportion of 1 percent, effected the greatest improvement in retarding the appearance of a nonspecific reaction. Antigen produced from cultures grown on beef-liver infusion agar appeared to possess such a satisfactory degree of sensitivity that its experimental production will be continued.

## STAINED ANTIGEN FOR DIAGNOSIS OF BANG'S DISEASE

In view of the manifest advantages of the whole-blood, stained-antigen test for pullorum disease in fowls, the development of a similar test for Bang's disease (infectious abortion) in cattle was undertaken, with encouraging results. The antigen consists of a dense suspension of three strains of *Brucella abortus* in phenolized salt solution, heavily stained with crystal violet. By standardized wire loops, measured portions of whole blood, citrated if desired, and of stained antigen are brought together on a glass plate. Development of agglutination in the mixture may be observed in a good light after 10 minutes, provided the temperature has been above 25° C. A portable test case containing the necessary materials, as well as convenient equipment for producing light and heat, has been devised for use in the field.

Comparative tests by the rapid, whole-blood, stained-antigen method and the tube-agglutination method were made on 1,725 cattle on various farms. The tests by the new method were made on the premises; those by the tube method were performed on samples of blood transmitted to the Experiment Station of the Bureau at Bethesda, Md. The agreement between the two methods was 96.9 percent, 274 animals being reported as positive reactors (positive at serum dilutions of 1:100 or more in the tube method) by both methods. With respect to disagreements, 46 animals were reported as negative by the tube test but as positive reactors by the new test; 7 animals afforded results in the reverse relation.

The stained-antigen test is being tried on a larger scale in the field through cooperation with the Tuberculosis Eradication Division. Sufficient antigen to make more than 8,000 tests has been distributed.

## HOG-CHOLERA INVESTIGATIONS

During the year there were produced for experimental work, principally the preparation of vaccines, 95,552 cc of hog-cholera virus. No anti-hog-cholera serum was produced since the supply on hand, 44,055 cc, was sufficient to meet demands. It was shipped chiefly to various farms of the Bureau. In addition, 10,500 cc of anticoli serum (swine) were produced for experimental purposes.

During the year it became clear that bottles used in the distribution of commercial virus and serum were often of such poor quality that alkalinity and insoluble matter could be imparted to the contents to a deleterious extent. As a result of the survey, definite specifications for the quality of such containers were recommended.

Certain advantages possessed by glycerin as a preservative for virus have been previously reported. This year, in two experiments, portions of a defibrinated virus blood were preserved, some with 40 percent of glycerin and the others with 0.5 percent of phenol, and were held in cold storage. After periods of 183 and 188 days, respectively, the glycerinated portions failed to show virulence, whereas the corresponding phenolized portions were still actively virulent. It is clear that the use of glycerin as a preservative significantly curtails virulence in comparison with the virulence of phenolized virus.

Efforts to find a satisfactory precipitin or agglutinin reaction of service in the diagnosis of hog cholera continued to be unsuccessful. Equipment for the accurate determination of hydrogen-ion concentration of blood by means of the glass electrode has been installed for use in the study of virus blood.

The potential economic importance of a successful vaccine against hog cholera was discussed in last year's report. Progress in the experimental work this year has been decidedly encouraging. On the basis of preliminary trials in which 7 chemical substances were used as attenuating agents, 3 were chosen for intensive study. Since the technic of the preparation of the vaccines cannot be described here in detail, it appears sufficient to designate the general classes of vaccines prepared from the substances. They were glycerinated vaccine, phenolized vaccine, and crystal violet vaccine. The method of preparation varied somewhat, but in general it consisted in holding the mixture of defibrinated virus blood and attenuating agent at such a temperature and over such a period that it no longer produced sickness when injected into pigs susceptible to hog cholera. For tests of potency, the prepared vaccine was injected into healthy, susceptible pigs. After an appropriate interval for the development of immunity, the pigs were then exposed to hog cholera through injection of virus.



The glycerinated vaccine was prepared in 18 lots, and was tested on 70 pigs. Virus injection followed 3 weeks after vaccine injection. Fifty-three of the pigs showed at most but slight reaction after virus injection, an immunization in 76 percent of the cases.

The phenolized vaccine was prepared in 87 lots, and each lot was tested on at least 2 pigs. A period of at least 2 weeks was found to be necessary for the establishment of immunity after vaccination. Satisfactory protection was afforded to 86 percent of the treated pigs and was found to persist for at least 2 months after vaccination. The vaccine appeared to retain its potency for at least 6 weeks in cold storage.

The crystal violet vaccine was prepared in 20 lots which were tested on 88 pigs. Virus injection followed 3 weeks after vaccination. It resulted in a severe reaction in the case of only one pig, which showed symptoms of pneumonia rather than of hog cholera. It is evident that further intensive and extensive work on the crystal violet vaccine is fully warranted because of 98.8 percent satisfactory protection. This vaccine is the invention of Dr. Dorset, and steps are being taken to obtain a patent covering the process and dedicated to the public.

### EXPERIMENT STATION

The Bureau's Experiment Station at Bethesda, Md., under the supervision of W. E. Cotton, superintendent, continued its independent investigations and provided facilities for other divisions of the Bureau to conduct experimental studies, especially those involving the use of large animals. The station's investigations, for the most part, have concerned Bang's disease (infectious abortion), tuberculosis, and communicable maladies that may be confused with foot-and-mouth disease.

#### BANG'S DISEASE

Studies of vaccination for the prevention and control of Bang's disease were continued during the year. Two experiments were conducted and have yielded some definite results.

One experiment was undertaken to determine whether the administration of massive doses of vaccine to unbred cattle is necessary to induce a serviceable immunity. Twenty virgin heifers near breeding age were used in this experiment, 14 of which were vaccinated and 6 used as controls. Three vaccines of different densities, but prepared from the same *Brucella abortus* strain of low virulence, were employed in the experiment. Vaccines nos. 1 and 2 consisted of saline suspensions of *Br. abortus* grown on a solid medium. The former was adjusted to a density 10 times that of tube 1 of the McFarland nephelometer and the latter to 2 times that of the former. Vaccine no. 3 was a 48-hour liver bouillon culture of the micro-organism and had a density equal to that of tube 1 of the McFarland nephelometer. Three heifers each received 2 cc of vaccine no. 1 subcutaneously; 3, 10 cc; and 2, 20 cc. Three heifers received 0.25 cc of vaccine no. 2 intradermically, and 3 received vaccine no. 3 (the bouillon culture) subcutaneously, 1 of them 5 cc, 1, 10 cc, and the third 20 cc. After the principals and controls were bred and had conceived, they were subjected to *Br. abortus* conjunctival exposure. Thirteen of the fourteen principals produced vigorous calves, and the remaining 1 gave birth to a dead calf. Attempts to isolate *Br. abortus* from the uterine material of the 14 heifers failed. The infection, however, was isolated from the colostrum of 2 of them. One of these had received 20 cc of vaccine no. 1 subcutaneously and the other 0.25 cc of vaccine no. 2 intradermically. Four of the six controls gave birth to premature calves, and *Br. abortus* was proved to be present in their uterine materials and colostrum. The results of the experiment indicate that the size of the dose of vaccine administered, within reasonable limits, may be a matter of less importance than has commonly been supposed and that a relatively small dose, provided it is viable, given subcutaneously, may possibly be desirable.

In the second vaccine experiment, the results of calfhood vaccination were compared with those derived from the vaccination of yearling unbred heifers. Thirteen calves and 10 yearlings were used in this experiment. Although results of the experiment have not revealed much difference in the degree of immunity induced by vaccination during calfhood and between 1 and 2 years of age, the results of repeated agglutination tests of the blood of the animals which were made subsequent to vaccination indicate that *Br. abortus* agglutinins, induced by vaccination, do not persist so long in the blood of calves as in the blood of more mature heifers.

In order to gain more definite information as to the practical value of calfhood vaccination, this method of dealing with the disease was inaugurated in a few herds in which difficulty was experienced by the owners in raising replacements free from the disease. The work has not yet been carried sufficiently far to justify drawing definite conclusions.

Considerable aid was rendered the Tuberculosis Eradication Division in connection with the Federal program for combating Bang's disease which was inaugurated during the year. Between October 22, 1934, and July 1, 1935, agglutination tests were made of 9,476 blood samples which were obtained from cattle in areas not far from the Experiment Station. Of these, 1,109 samples gave positive reactions to the test, and 320 gave suspicious reactions. These figures comprise the results obtained from original tests of herds as well as first and second retests. In addition to the regular testing, comparative tests were made of blood samples and antigens from a number of sources as a means of enabling different laboratories to check their results.

The cooperative abortion-disease projects, begun in 1929, with eight State universities and experiment stations, were continued and several papers giving results achieved were presented for publication.

### TUBERCULOSIS

Studies in cattle of so-called "skin-lesion" reactors to tuberculin have been continued, but nothing of a nature to disprove the conclusions previously stated, that this form of sensitization is due to an acid-fast micro-organism dissimilar in pathogenicity to any of the recognized types of tubercle bacilli, has been observed.

In an effort to determine whether tubercle bacilli in moist soil would become so altered that they would no longer produce lesions of tuberculosis, but might be a source of infection in so-called "skin lesions" or, at least, cause a sensitization to tuberculin, the following experiment was made.

In August 1933, a plot 8 by 16 feet in a low corner of a field pen was enclosed, and on the ground of this plot was sprinkled evenly the growth of nine cultures of bovine tubercle bacilli suspended in 5 gallons of water. The soil was still found to be infective after 3 months but not after 4 months. In January 1934, one adult bovine was placed in this enclosure during the daytime when the ground was not frozen and in April 1934, two yearling steers were scarified, each on the right hind foot, and placed in the field pen and all animals were fed in the infected enclosure. The animals were kept in this manner until April 1935 when they were tested with tuberculin without reaction. These animals were killed during June 1935, but no lesions of tuberculosis were found either under the skin or in the internal glands.

### VESICULAR EXANTHEMA OF HOGS

In the last report, mention was made under the title "Vesicular Stomatitis" of a disease in garbage-fed hogs in California similar to the exanthema of vesicular stomatitis and foot-and-mouth disease. To this apparently new disease, Jacob Traum, of the University of California, has given the designation "vesicular exanthema of hogs."

During the last year, three samples of virus from different sections of California were received for study, in addition to the virus previously reported. All four produced practically the same character of symptoms in hogs, namely, an acute rise in temperature followed by swellings and vesicular eruptions on the pads, interdigital spaces and coronary bands of the feet and on the snout, lips, and occasionally on the tongue.

The lesions of vesicular exanthema of hogs are so similar to those of vesicular stomatitis and foot-and-mouth disease that they can be differentiated from those of the two last-mentioned diseases only by the inoculation of other species of animals.

Two of the four samples of virus caused lesions on the tongue of horses when inoculated on that site; the other two appeared to be innocuous for horses. Guinea pigs, cattle, sheep, and goats apparently are immune to this virus.

Cross-immunity tests, based on artificial inoculation, of the four samples of virus studies, show each to be of a different type, as hogs can be passed successively through each type after an interval of from 1 to 2 months between inoculations; whereas hogs which have passed through one type of infection resist infection to the same type of virus. This is analogous to the results obtained in vesicular stomatitis, in which two immunologically different



types have been observed, and in foot-and-mouth disease in which three types have been described.

In vesicular stomatitis, investigations can be carried on at a relatively low cost due to the fact that guinea pigs are susceptible to this disease. In vesicular exanthema of hogs, only swine and, at times, horses, are susceptible; for this reason experimentation is not only tedious but costly.

#### VESICULAR STOMATITIS

The two known types of virus of this disease have been kept alive by passage through guinea pigs for more than 9 years. This has provided immune animals to help in making diagnoses from materials from animals having symptoms resembling those of foot-and-mouth disease, as well as to keep the viruses for study by the Bureau and other agencies.

Though the viruses have been continuously passed through guinea pigs for so many years, their virulence for these animals does not seem to have been reduced and both viruses are still capable of producing marked characteristic lesions of the disease on inoculation in cattle.

#### MOVING THE EXPERIMENT STATION TO BELTSVILLE

Construction work on the building of the Experiment Station at its new location, Beltsville, Md., where the station will become a part of the Beltsville Research Center, has reached a stage which has permitted the moving of most of the equipment and animals. Owing, however, to certain experiments in progress at Bethesda, which would be difficult to move, a few months of the new year will likely have passed before the movement to Beltsville will have been entirely completed.

#### FIELD INSPECTION DIVISION

During the year the Field Inspection Division, under the direction of George W. Pope, continued to conduct activities relating to control and eradication of sheep and cattle scabies and certain other animal diseases. This Division also administered various regulations designed to prevent the introduction of live-stock diseases of foreign origin and to assure the inspection and humane handling of export animals.

#### ERADICATION OF SCABIES

Sheep-scabies eradication was continued in cooperation with authorities of various States. During the year 16,295,011 inspections were made in the field and 1,490,450 dippings were supervised. Flocks in which infection was found included 79,960 sheep, approximately as many as in the previous year. In the great range areas of the West and Southwest only a few scattered cases were found. These were in Arizona, New Mexico, and Texas, and most of the cases resulted from reinfection. Aside from this condition the entire range area originally quarantined for sheep scabies appears to be free from the disease. The principal centers of infection at present are South Dakota, Iowa, and Ohio. In South Dakota drought conditions prevented any progress during the year. In Iowa a cooperative eradication campaign was carried on with satisfactory results. In Ohio new legislation was adopted which is designed to make better control and final eradication possible.

Cooperative cattle-scabies eradication also was continued, but as all the districts that were infected at the beginning of the year were within the region in which severe drought occurred, very little progress was made toward eradication except in Wyoming, where gratifying results were achieved during the winter and spring. As a result of the emergency movement of cattle, there was considerable spread of the infection in the area comprising southeastern Colorado and western Kansas, and some in Nebraska. The disease also gained entrance into North Carolina, but prompt measures were taken to eradicate the infection, with apparent success. Inspections in the field totaled 2,106,801, and 330,900 dippings were supervised. The number of cattle in infected herds was 219,338, a considerable increase over the year before.

Inspections indicate that sarcoptic scabies has been eradicated in the range States where it previously existed, except in Nebraska. This variety of scabies is known to exist in some of the Midwestern States.

In a district of Texas where scabies among goats has existed, of the 77,609 inspected infection was found in only two herds numbering 1,918 head.

No reports of scabies among horses in the previously infected district in Montana were received during the year. It appears, therefore, that the disease has been eradicated.

#### ERADICATION OF DOURINE

No systematic work in the eradication of dourine was carried on during the year. A considerable number of horses, shipped for slaughter from the limited area in which it is thought some infection may remain, were tested; 10 gave positive reactions, indicating that the remaining infection is slight. State quarantines over this area are being maintained.

#### CONTROL OF ANTHRAX

The country continued to be free from any serious outbreaks of anthrax. Bureau employees again cooperated with officials of the Indian Service in administering preventive treatment to cattle owned by Indians on reservations where severe outbreaks occurred a few years ago.

#### INSPECTION OF HORSES FOR INTERSTATE SHIPMENT

Bureau veterinarians inspected 724 horses and 158 mules for interstate shipment, in connection with their regular duties. Of these, 228 head were subjected to the mallein test without any positive reactions.

#### INSPECTION AND QUARANTINE OF IMPORTED ANIMALS

A careful inspection was made of all horses, ruminants, and swine from foreign countries. The volume of imports was greatly increased over that of preceding years. This was apparently due to the demand for cattle and sheep from Canada and Mexico. There was a somewhat larger number of cattle imported from the Channel Islands and also an increase in the number of wild ruminants, especially antelopes intended for exhibition purposes at zoological parks. Several applications to import domestic ruminants were necessarily refused favorable consideration owing to the existence of foot-and-mouth disease in the country of origin.

In table 1 are shown the number and kinds of animals imported during the year.

TABLE 1.—*Animals imported,<sup>1</sup> fiscal year 1935*

#### INSPECTED BUT NOT QUARANTINED

Port of entry	Cattle	Swine	Sheep	Goats	Horses and mules	Asses	Other animals
Baltimore.....					24		10
Boston.....	22				10	2	17
Hawaii.....			50				3
New Orleans.....					7	3	5
New York.....					377	4	12
San Diego.....							6
San Francisco.....					25		
San Juan, P. R.....	2,515	88	38	15	16		7
Canadian border ports.....	83,055	528	1,690	6	6,267	1	79
Mexican border ports.....	<sup>2</sup> 175,586	100	13,263	5	5,834	11	63
Total.....	261,178	716	15,041	26	<sup>3</sup> 12,560	21	202

#### INSPECTED AND QUARANTINED

Boston.....							69
New York.....	179		40	3	15		28
San Francisco.....			1		13		1
San Juan.....							3
Canadian border ports.....	59						
Mexican border ports.....							
Total.....	238		41	3	28		101

<sup>1</sup> 2,348 cattle and 19 deer from Mexico were refused importation owing to tick infestation, and 1,219 cattle were rejected owing to the infection of scabies. <sup>2</sup> Cattle from Canada failed to pass inspection on account of infected udders.

<sup>2</sup> This number does not include 4,327 Mexican cattle passing through the United States under bond for reentry into Mexico, which cattle were inspected at time of entry.

<sup>3</sup> Of this number, 1,354 were mules.



Inspections of 2,526 domestic fowls and 50 pigeons were made at ports of entry. The countries of origin were England, Scotland, Australia, Spain, Venezuela, Dominican Republic, Cuba, and other islands of the West Indies.

Inspectors at ports of entry inspected and quarantined 23,358 quail from Mexico. This service was rendered for the Bureau of Biological Survey, which administers regulations governing the importation of birds.

Customs officers and employees of the Bureau of the Public Health Service continued to render the Bureau valuable cooperative assistance. Public Health surgeons at port quarantine stations obtained for Bureau of Animal Industry inspectors 11,012 declarations of shipmasters concerning the presence or absence, on their vessels, of prohibited meats and livestock. This was an increase of 218 over the preceding year. Of the declarations obtained, 2,476 showed the presence of prohibited meats on board and 14 showed the presence of prohibited livestock. The 36 prohibited animals on these 14 vessels were slaughtered and the spaces occupied by them on the vessels disinfected.

#### INSPECTION AND SAFE TRANSPORT OF EXPORT ANIMALS

In order to meet requirements of receiving countries and comply with regulations of the Department for the inspection, humane treatment, and safe transport of animals for exportation, 29,382 animals of various kinds were inspected prior to their shipment. This was an increase over the preceding year of nearly 19,000 head. Supervision was also maintained over the equipment of vessels carrying export livestock to assure proper space, fittings, and care. In table 2 are shown the number and kinds of animals inspected for export.

TABLE 2.—*Inspection and testing of animals for export, fiscal year 1935*

Kind of animal	To Canada	To other countries	Total	Kind of animal	To Canada	To other countries	Total
Cattle.....	153	2,777	2,930	Mules.....	29	3,450	3,479
Swine.....		676	676	Asses.....		24	24
Sheep.....	2,446	13,162	15,608	Other animals.....		2	2
Goats.....	4	5,149	5,153				
Horses.....	322	1,188	1,510	Total.....	2,954	26,428	29,382

#### CONTROL OF IMPORT ANIMAL BYPRODUCTS, HAY, AND STRAW

A careful supervision was maintained over various animal byproducts and hay and straw entering the United States from countries infected with foot-and-mouth disease or rinderpest. There was consistent adherence to the plan of allowing restricted import hides, skins, and other animal byproducts to proceed only to tanneries or other establishments properly equipped for their segregated storage and for their disinfection or the disinfection or control of effluents incident to their manufacture. Cars numbering 941 which were used for transporting restricted materials of this kind were disinfected after such use.

During the year an amendment was issued to the regulations which enabled the Bureau to place definite restrictions upon wool of foreign origin which had not been freed from dung locks. It was also provided in this amendment that hay or straw for feeding purposes might be imported without the accustomed 90 days' quarantine, when shown by the certificate of an American consular officer to have been produced in a section of the country of origin in which neither foot-and-mouth disease nor rinderpest existed.

Importers were required to destroy hay- and straw-packing materials from countries infected with foot-and-mouth disease or rinderpest unless it was shown by an acceptable certificate to have been properly disinfected before use.

Supervision was maintained over calf stomachs imported for the manufacture of rennets and over animal glands for the manufacture of biological products when originating in countries infected with foot-and-mouth disease or rinderpest.

An important duty of inspectors at various ports of entry was the enforcement of the prohibition of the landing of fresh or frozen meats or garbage

derived from such meats in instances of vessels which had been provisioned in countries where foot-and-mouth disease or rinderpest exists.

The practice of controlling importations of animal manure through the issuance of permits was continued.

### MEAT INSPECTION DIVISION

The activities of the Meat Inspection Division were directed by R. P. Steddom from July 1 to December 31, 1934, and following his statutory retirement the work was under the direction of A. J. Pistor as chief of the Division. At establishments operated under this inspection, 72,736,244 animals were slaughtered (a decrease of 6.23 percent from the preceding year) and 7,344,706,539 pounds of meat and meat food products were cured, canned, chopped, rendered, refined, and otherwise prepared. In addition special inspection service involving the examination of food animals and their meat was conducted for the Federal Surplus Relief Corporation and Civilian Conservation Corps. Cooperation was extended to the Navy Department, Marine Corps, Veterans' Administration, and several other branches of the Government in the selection and preparation of meat supplies.

#### GENERAL MEAT INSPECTION

Inspection was conducted at 746 regular establishments located in 247 cities and towns, as compared with 741 regular establishments in 255 cities and towns during the fiscal year 1934. Inspection was inaugurated at 24 regular establishments and withdrawn from 40, as compared with 15 and 35, respectively, during the preceding year. Inspection was withdrawn in the cases enumerated on account of discontinuance of operations involving the preparation of meat or meat food products for interstate or foreign commerce. At the close of June 30, 1935, there were 706 regular establishments in 247 cities and towns operating under inspection.

#### ANTE-MORTEM AND POST-MORTEM INSPECTION

The results of the ante-mortem and post-mortem inspections are given in tables 3 to 6, inclusive. Tables 4, 5, and 6 show the diseases and number of condemnations on ante-mortem and post-mortem inspections.

TABLE 3.—*Ante-mortem and post-mortem inspection of animals, fiscal year 1935*

Kind	Ante-mortem inspection				Post-mortem inspection		
	Passed	Suspected <sup>1</sup>	Condemned <sup>2</sup>	Total	Passed	Condemned	Total
Cattle.....	12,414,309	400,932	14,104	12,829,345	12,675,682	133,766	12,809,448
Calves.....	7,103,387	9,618	9,689	7,122,694	7,087,865	28,158	7,116,023
Sheep and lambs.....	18,280,451	2,752	9,010	18,292,223	18,245,367	34,723	18,280,090
Goats.....	98,073	1	1,649	99,723	96,762	1,312	98,074
Swine.....	34,350,849	65,089	13,858	34,429,796	34,303,470	109,847	34,413,317
Horses <sup>3</sup> .....	19,287	5	43	19,335	19,148	144	19,292
Total.....	72,266,366	478,397	48,353	72,793,116	72,428,294	307,950	72,736,244

<sup>1</sup> "Suspected" is used to designate animals suspected of being affected with disease or condition that may cause condemnation in whole or part on special post-mortem inspection.

<sup>2</sup> For additional condemnations see tables 4 to 6, inclusive.

<sup>3</sup> Horses are slaughtered and the meat thereof handled and prepared in establishments separate and apart from those in which cattle, calves, sheep, goats, and swine are slaughtered and the meat thereof handled and prepared.



TABLE 4.—*Number of animals condemned for various diseases and conditions on ante-mortem inspection, fiscal year 1935*

Cause of condemnation	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Abscess.....					54	
Arthritis.....					12	
Ascites.....					2	
Asphyxia.....			5		7	
Blackleg.....		2	1			
Carcinoma.....	68					
Emaciation.....	78	33	16		1	
Enteritis.....					3	
Epithelioma.....	13					
Hog cholera.....					507	
Immaturity.....		89				
Influenza.....					14	
Injuries.....	25	22			5	
Metritis.....	4					
Moribund <sup>1</sup> .....	13,867	9,537	8,977	1,649	12,643	43
Paresis.....	1					
Pericarditis.....	1					
Peritonitis.....	1				1	
Pneumonia.....	11	1	5		73	
Pregnancy and recent parturition.....	5					
Pyemia.....					4	
Pyrexia.....	25	5	5		465	
Septicemia.....	3		1		63	
Tetanus.....	1					
Toxemia.....					2	
Tumors.....					2	
Tympanitis.....	1					
Total.....	14,104	9,689	9,010	1,649	13,858	43

<sup>1</sup> Includes animals found dead in the ante-mortem pens when inspection was conducted.TABLE 5.—*Number of animals condemned for various diseases and conditions on post-mortem inspection, fiscal year 1935*

Cause of condemnation	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Actinomycosis.....	1,108	72			1	
Anaplasmosis.....	8	2				
Anthrax.....					149	
Arthritis and other bone diseases.....	152	225	395		5,692	
Asphyxia.....	2	1	26		437	
Blackleg.....	7	9				
Caseous lymphadenitis.....			6,234	1		
Cellulitis.....					7	
Contamination.....	49	18	27	3	1,763	
Cysticercosis.....	257	26	403		38	
Dropsical diseases.....	50	6	10		45	
Emaciation.....	54,453	12,192	9,713	1,207	849	34
Gangrene.....	23	1			1	1
Hog cholera.....					12,755	
Hydronephrosis.....	6		4		59	
Icterus.....	159	331	1,973	30	3,845	
Immaturity.....		6,290				
Influenza.....					5	
Injuries.....	6,639	864	1,385	4	2,485	1
John's disease.....	2					
Melanosis.....	70	94	71		101	37
Moribund.....	8				1	
Necrobacillosis.....	10				9	
Necrosis.....	12					
Omphalophlebitis.....		47				
Parasitic diseases.....	62	2	9		65	
Pneumonia, pleurisy, enteritis, peritonitis, etc.....	25,326	5,681	11,347	36	25,242	37
Pregnancy and recent parturition.....	150		25		4	
Pseudoleukemia.....	1,106	50	13		150	
Septicemia and pyemia.....	12,093	1,863	2,442	20	24,314	22
Sexual odor.....	1		2	6	5,110	
Skin diseases.....	1	3			143	
Splenetic fever.....	4	2				
Toxemia.....	13	2	1		5	
Tuberculosis.....	28,225	283	6	1	26,133	
Tumors, carcinomata, sarcomata, etc.....	3,606	86	100	3	344	12
Uremia.....	140	8	537	1	95	
Xanthosis.....	24					
Total.....	133,766	28,158	34,723	1,312	109,847	144

TABLE 6.—*Number of parts of carcasses,<sup>1</sup> of animals indicated, condemned for various diseases and conditions on post-mortem inspection, fiscal year 1935*

Cause of condemnation	Parts of carcasses of—					
	Cattle	Calves	Sheep and lambs	Goats	Swine	Horses
Actinomycosis.....	202,280	8,045	—	—	1	—
Arthritis and other bone diseases.....	7	1	4	—	121	—
Caseous lymphadenitis.....	—	—	10	—	—	—
Cellulitis.....	3	1	—	—	192	—
Contamination.....	121	1,094	2	—	3,321	—
Edema.....	5	—	—	—	—	—
Hydrocephalus.....	—	—	—	—	—	—
Injuries.....	1,617	95	94	—	26,771	10
Melanosis.....	31	31	2	—	1	1
Necrobacillosis.....	11	—	—	—	—	—
Necrosis.....	7	—	—	—	—	—
Tuberculosis.....	40,761	471	—	—	235,831	—
Tumors and abscesses.....	10,432	6,118	60	1	418,563	47
Xanthosis.....	7	—	—	—	—	—
Total.....	255,232	15,857	172	1	684,801	58

<sup>1</sup> In addition to the above parts, 1,005,210 cattle livers and 49,108 calf livers were condemned on post-mortem inspection.

## INSPECTION OF MEAT AND PRODUCTS

The inspection and supervision of meat and products prepared and processed are shown in table 7, which is a record only of inspection performed and not a statement of the actual quantity prepared. Market inspection to facilitate interstate delivery of meat and products was conducted in 16 cities.

TABLE 7.—*Meat and meat food products prepared and processed under supervision, fiscal year 1935<sup>1</sup>*

Product	Quantity	Product	Quantity
	<i>Inspection pounds<sup>2</sup></i>		<i>Inspection pounds<sup>2</sup></i>
Cured:		Compound and other substitutes for lard.....	474,843,064
Beef.....	148,906,182	Oleo stock and edible tallow.....	77,034,240
Pork.....	2,034,922,159	Oleo oil.....	65,232,666
All other.....	1,888,523	Oleo stearin.....	35,021,359
Sausage.....	765,033,254	Oleomargarine.....	93,200,599
Canned:		Miscellaneous.....	1,692,612,025
Beef.....	625,486,276	Horse meat:	
Pork.....	145,143,786	Cured.....	6,794,335
All other.....	45,853,844	Chopped.....	210,210
Product passed for cooking:		Chopped horse meat and beef.....	165,881
Beef.....	5,108,981	Chopped horse meat and mutton.....	2,740
Pork.....	4,771,073	Canned.....	7,597,444
All other.....	1,509,984	Canned horse meat and beef.....	79,164
Pork to be eaten uncooked.....	80,509,987	Canned horse meat and mutton.....	1,394,740
Meat extract.....	140,357	Total.....	7,344,706,539
Lard.....	1,030,337,416		
Lard oil.....	780,663		
Lard stearin.....	185,587		

<sup>1</sup> The following quantities of meat and meat food products were condemned on reinspection and destroyed for food purposes on account of having become sour, tainted, rancid, unclean, or otherwise unfit for human food: Beef, 3,779,215 pounds; pork, 3,874,893 pounds; mutton and lamb, 182,985 pounds; veal, 149,698 pounds; horse meat, 29,324 pounds; goat meat, 88 pounds; total, 8,016,203 pounds.

<sup>2</sup> This term represents the total volume of inspection. The figures do not represent actual production, as the same product may have been inspected and recorded more than once in the process of manufacture.

## MEAT AND PRODUCTS CERTIFIED FOR EXPORT

During the fiscal year 35,743 official meat-inspection certificates were issued to cover the exportation of the following products: Beef and beef products, 48,310,359 pounds; mutton and lamb and their products, 2,852,853 pounds; pork



and pork products, 345,702,436 pounds; horse meat and its products, 1,238,712 pounds; total, 398,104,360 pounds. There were also issued 4,191 certificates covering the exportation of 35,933,394 pounds of inedible animal products.

### EXEMPTION FROM INSPECTION

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by farmers on farms or to retail butchers and dealers supplying their customers. Farmers, butchers, and dealers, however, are required to furnish shippers' certificates, thus providing the Bureau with a record of their shipments. In addition, the retail butchers and dealers, in order to ship meat and meat-food products in interstate or foreign commerce, are required to obtain certificates of exemption from inspection. The number of such certificates outstanding at the close of the year was 1,069. During the year 60 certificates were canceled on account of the certificate holders' retiring from business, ceasing to make interstate shipments, change of address, change of ownership, insanitary conditions, failure to furnish required data, use of prohibited preservatives, and other causes.

During the year 68,288 shipments were made by retail butchers and dealers holding certificates of exemption as compared with 62,445 shipments during the fiscal year 1934. The shipments of the year covered products as shown in table 8.

TABLE 8.—Shipments by retail butchers and dealers under certificates of exemption, fiscal year 1935

Product	Car-casses	Quantity	Product	Car-casses	Quantity
	Number	Pounds		Number	Pounds
Cattle (4,674 quarters).....	1, 168	481, 931	Cured meats.....		842, 820
Calves.....	17, 665	1, 295, 210	Lard.....		57, 104
Sheep and lambs.....	1, 022	38, 135	Sausage.....		254, 879
Swine.....	97	8, 764	Miscellaneous (headcheese, suet, scrapple, compound, etc.).....		73, 805
Beef, fresh.....		3, 452, 274	Total.....	19, 952	8, 029, 280
Veal, fresh.....		470, 169			
Mutton and lamb, fresh.....		628, 226			
Pork, fresh.....		425, 963			

During the year, 51,918 interstate shipments were made of meat and meat food products from animals slaughtered by farmers on the farms, as compared with 47,094 shipments during the fiscal year 1934. The products composing these shipments are shown in table 9.

TABLE 9.—Shipments of farm-slaughtered meat and products, fiscal year 1935

Product	Car-casses	Quantity	Product	Car-casses	Quantity
	Number	Pounds		Number	Pounds
Cattle (3,511 quarters).....	878	340, 409	Cured meats.....		425, 639
Calves.....	66, 729	5, 076, 772	Lard.....		12, 434
Sheep and lambs.....	3, 864	133, 815	Sausage.....		127, 651
Swine.....	1, 345	53, 486	Miscellaneous (scrapple, headcheese, livers, sousé, etc.).....		77, 081
Beef, fresh.....		32, 386	Total.....	72, 816	6, 582, 368
Veal, fresh.....		191, 290			
Mutton and lamb, fresh.....		2, 439			
Pork, fresh.....		108, 966			

## INSPECTION OF IMPORTED MEAT

Table 10 shows the inspection of imported meat and meat food products.

TABLE 10.—*Imported meat and meat food products inspected and passed, fiscal year 1935*

Country of origin	Fresh and refrigerated meat		Canned and cured meat	Other meat products	Total weight
	Beef	Other classes			
	Pounds	Pounds	Pounds	Pounds	Pounds
Argentina.....			23, 205, 992	25, 077, 607	53, 283, 599
Australia.....	40, 391	421		2, 125, 357	2, 166, 169
Brazil.....			12, 315, 833	3, 353, 335	15, 669, 168
Canada.....	4, 260, 829	1, 602, 277	524, 359	2, 804, 430	9, 191, 895
New Zealand.....	1, 334, 818	10, 575	715	3, 795, 559	5, 141, 667
Paraguay.....				419, 643	419, 643
Uruguay.....			29, 232, 934	5, 294, 527	34, 527, 461
Other countries.....	72, 398	131	2, 281, 030	359, 213	2, 712, 772
Total.....	5, 708, 436	1, 615, 404	72, 560, 863	43, 229, 671	123, 112, 374

Table 11 shows the quantities of foreign meat and products excluded from the country because of unsoundness, presence of prohibited preservatives, incorrect labeling, or other failure to comply with the regulations.

TABLE 11.—*Imported meat and meat food products condemned and refused entry, fiscal year 1935*

Product	Condemned	Refused entry
	Pounds	Pounds
Beef.....	729, 547	5, 337
Pork.....	388	1, 346
Total.....	729, 935	6, 683

## IMPORTATION OF ANIMAL CASINGS

Animal casings from 48 foreign countries were admitted as follows: On certificates, 14,166,563 pounds; on disinfection, 1,879,657 pounds; dried casings, 159,719 pounds; total, 16,205,939 pounds. Casings amounting to 10,448 pounds offered for importation were rejected and removed from the United States.

## INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT

By request of other branches of the Government, reinspections of meat and meat food products were conducted as shown in table 12, to determine whether the articles remained wholesome and conformed to certain specifications.

TABLE 12.—*Inspections for other branches of the Government, fiscal year 1935*<sup>1</sup>

Branch of Government	Passed	Rejected	Branch of Government	Passed	Rejected
	Pounds	Pounds		Pounds	Pounds
Navy Department.....	45, 869, 646	1, 715, 244	War Department (Army Engineering Corps).....	496, 050	6, 353
Veterans' Administration (hospitals and homes).....	4, 985, 159	119, 138	National Zoological Park.....	152, 734	834
National Homes Service.....	2, 877, 294	102, 439	Tennessee Valley Authority.....	124, 473	
Marine Corps.....	2, 620, 813	77, 298	Alaskan Engineering Commission.....	86, 975	25
Department of Justice (Federal penitentiaries).....	2, 570, 281	64, 354	Shipping Board.....	25, 697	1, 462
Department of Interior (Bureau of Indian Affairs).....	972, 628	18, 278	Panama Railroad.....	1, 507	
Coast Guard.....	529, 247	8, 561	Total.....	61, 312, 504	2, 113, 961

<sup>1</sup> Not including inspections for emergency agencies.



### INSPECTIONS FOR DROUGHT-RELIEF CATTLE-AND-SHEEP CAMPAIGN

In connection with official relief measures in drought-stricken areas and in the reduction of numbers of cattle and sheep for which there was insufficient feed, the Bureau aided through various inspection services.

At the request of the Federal Surplus Relief Corporation and various State relief organizations, ante-mortem and post-mortem inspections were made of nearly 4,750,000 animals, chiefly cattle and sheep, and Bureau inspectors supervised the boning, freezing, canning, shipping, and storage of the meat accruing to the relief organizations. In addition, Bureau supervision was extended to the relief organizations in the handling and tanning of sheepskins and in the grading, in accordance with commercial standards, of the hides of cattle and calves and the bundling, shipping, and storing of hides accumulated during the campaign.

### INSPECTIONS FOR CIVILIAN CONSERVATION CORPS

At the request of the War Department the meat-inspection service made inspections from July 1, 1934, to June 30, 1935, inclusive, for the Civilian Conservation Corps. This work included the ante-mortem and post-mortem examination of 38,074 food animals, principally swine. Of the meat passed upon post-mortem inspection, 1,490,570 inspection pounds were reinspected during the various stages of processing and preparing it for food purposes.

### MEAT-INSPECTION LABORATORIES

Analyses and examinations of meat and products were conducted in the meat-inspection laboratories situated in the several districts throughout the country. The total number of samples of various kinds examined was 39,136. These included samples of meats, meat food products, fats, oils, cereals, spices, curing materials, colors, denaturing material, water, and various other articles.

It was found that 3,365 samples were not in accordance with the regulations. Of these 2,420 represented articles prepared in domestic establishments. The principal faults found were excessive added water in sausage, improper application of artificial color to sausage casings, and failure to declare added substances permitted to be used under appropriate declaration. Of the samples found at fault, 680 represented substances offered for use in connection with the preparation of meat and meat food products and were excluded on account of the laboratory findings. Of 1,572 water samples collected, 212 were found to be polluted. Corrective action was taken in all cases to eliminate the cause of pollution. Samples representing 250 consignments of meat and meat food products offered for importation from foreign countries were found at fault. Most of these were incorrectly labeled and were admitted after correction of the labels, a few consignments being excluded.

### LABELING MEAT AND MEAT FOOD PRODUCTS

During the year 17,465 labels and other markings for meat and meat food products were approved, whereas 1,216 were disapproved, principally because of the inclusion of statements or designs which were false or misleading as to quality, quantity, ingredients, origin, or disease-preventive or curative properties.

### DRAWINGS AND SPECIFICATIONS

A considerable number of drawings and specifications of proposed new buildings, additions, cases of remodeling, and lay-outs of equipment and facilities were examined. The purpose of this supervision is to insure that means are provided for sanitation and the conduct of efficient inspection. In this work good cooperation was generally extended by establishments.

### PACKERS AND STOCKYARDS DIVISION

The work of the Packers and Stockyards Division was directed during the year by A. W. Miller, chief. Under the Packers and Stockyards Act the activities involved supervision over the operations and practices of packers, stockyard companies, market agencies, and dealers, and rates and charges for stockyard services. Under the livestock quarantine laws and regulations the activities included the inspection of all livestock received at public stockyards,

enforcement of the 28-hour law, and cooperation with the various States in applying their laws and regulations designed to prevent the introduction of animal diseases.

#### FORMAL PROCEEDINGS UNDER THE PACKERS AND STOCKYARDS ACT

On July 1, 1934, nine formal dockets were pending. During the year 23 were instituted and final action was taken on 17 cases. Fifteen were pending on June 30, 1935. Details of each of the formal dockets are given in a separate publication which may be had on request.

#### CASES IN COURT PERTAINING TO THE PACKERS AND STOCKYARDS ACT

A statutory court of three Federal judges in Omaha, Nebr., on July 7, 1934, handed down an opinion sustaining an order of the Secretary prescribing a schedule of reasonable rates for the Union Stock Yards Co. of Omaha. By order of the court the company returned excess charges to shippers in the amount of approximately \$60,000 and put the rates prescribed by the Secretary into effect on September 1, 1934.

On September 21, 1934, the United States Circuit Court of Appeals in Wilmington, Del., issued an opinion adverse to an order of the Secretary, which had directed the Wilmington Provision Co., Inc., of Wilmington, Del., to cease and desist from certain violations of title II of the Packers and Stockyards Act. The court set aside the order of the Secretary on the ground that no violation was shown. No appeal was taken from this decision.

In October 1934, a statutory court of three Federal judges in Kansas City, Mo., issued an opinion sustaining the validity of an order of the Secretary prescribing a schedule of reasonable rates for buying and selling livestock on a commission basis at the Kansas City stockyards. The court dissolved a temporary restraining order previously entered. Commission men respondents, members of the Kansas City Livestock Exchange, petitioned the court for a rehearing, and this was denied by the court in an opinion handed down on June 20, 1935. The commission men were arranging for an appeal to the Supreme Court of the United States at the close of the year.

In November 1934, a statutory court of three Federal judges, on application of commission firms at the market in Denver, Colo., issued an order temporarily restraining the enforcement of a schedule of reasonable rates prescribed by the Secretary for buying and selling livestock on a commission basis at the Denver stockyards. Arguments on the merits of the case were made before the court on February 14 and 15, 1935. A decision of the court had not been handed down at the close of the year.

On December 31, 1934, a statutory court of three Federal judges in Chicago, Ill., handed down an opinion upholding the validity of an order of the Secretary prescribing a schedule of reasonable rates for buying and selling livestock on a commission basis at the Chicago stockyards. The respondent firms, members of the Chicago Livestock Exchange, were arranging at the close of the year to appeal from this decision to the Supreme Court of the United States.

On May 1, 1935, a statutory court of three Federal judges in St. Joseph, Mo., handed down an opinion sustaining an order of the Secretary prescribing a schedule of reasonable rates to be charged by the St. Joseph Stock Yards Co. and denying a petition filed by the company for a rehearing. At the close of the year the company was arranging for an appeal to the Supreme Court of the United States.

#### STOCKYARDS

On June 30, 1934, there were 99 stockyards posted as coming within the jurisdiction of the act. During the year 12 stockyards were posted and 2 were released. Owing to the merging of 2 stockyards at Atlanta, Ga., and 2 at Richmond, Ky., the number of stockyards posted under the act at the close of the year was 107.

#### REGISTRATIONS

On June 30, 1935, there were 1,449 market agencies and 2,798 dealers registered to operate at posted stockyards. During the year 291 market agencies and 210 dealers were registered, and 260 market agencies and 191 dealers were placed on the inactive list.



### RATES AND CHARGES

Appraisals of the property and an audit of the books and records of the Cleveland Union Stock Yards Co., of Cleveland, Ohio, were completed, and the company waived a hearing regarding the reasonableness of its rates. The Secretary thereupon issued an order, to which the company consented, setting out findings and prescribing a schedule of rates and charges. The order contains a provision to the effect that the rates therein prescribed may be modified on a showing by the company that they are not yielding the revenue found to be reasonable in the order. One rate was so modified during the year.

A hearing was held at Fort Worth, Tex., on the reasonableness of the rates charged by commission firms at that market, and an oral argument was held before the Secretary. Briefs were filed and a final decision in the case was pending at the close of the year.

Appraisals of the property and audits of the books and records of the Wichita Union Stock Yards Co. at Wichita, Kans., were completed during the year. The Secretary issued an order based on the information procured from the appraisals, audits, and a study of the services and facilities and found that the existing rates were not yielding an amount in excess of a fair return on the fair value of the used and useful property, nor were they likely to do so in the near future. On these grounds the case was dismissed without prejudice.

A hearing was completed on the rates of the Denver Union Stock Yards Co., at Denver, Colo., and arrangements for oral argument were being made at the close of the year.

An order was issued prescribing a schedule of reasonable rates to be charged by the Sioux City Stock Yards Co. at Sioux City, Iowa. The company filed a petition with the Secretary asking for a rehearing and this was denied. The rates prescribed in the order were then put in effect by the stockyard company. Later the company petitioned to have the rates increased somewhat, and the petition was under consideration at the close of the year.

A hearing was held respecting the reasonableness of the commission rates at the Ogden and North Salt Lake, Utah, markets, and an order was being prepared at the close of the year.

### BONDS

Market agencies and dealers in general have complied with the bond regulation, but in those cases in which bonds were not furnished and could not be obtained through informal action, formal proceedings were instituted to compel compliance with the regulation.

### TRADE PRACTICES

Supervisors made numerous investigations and reports on general marketing conditions. They also assisted in handling matters relating to the filing of tariffs and regulations of market agencies and stockyard companies. Many complaints involving alleged violations of the various provisions of the act were received and carefully investigated by supervisors and special investigators in the field. The hearing involving alleged violations of title II of the act by a group of packers operating in certain Southern States, which was commenced in the previous fiscal year, continued for a period of several months and was finally concluded during this year. Approximately 1,000 witnesses appeared and testified during the course of this hearing; the transcript of testimony comprises about 25,000 pages in addition to voluminous exhibits. Briefs were filed by counsel, and arrangements for oral arguments were being made at the close of the year.

As during past years, a considerable number of trade-practice audits of the records of commission firms and dealers were made at various stockyards. Some of these audits revealed conditions that required the institution of formal proceedings, the substance of which is set out in a digest of dockets in another publication.

### SCALES AND WEIGHING

Bureau weight supervisors visited practically all posted stockyards during the course of the year. They inspected and supervised tests of scales and investigated weighing operations in general. Defective scales or those found not weighing within the tolerance required by the Bureau were repaired or corrected and placed in a satisfactory weighing condition. Several additional

stockyards procured equipment of the type recommended by the Bureau for testing livestock scales, and in general the Bureau received good cooperation in the scale-testing work.

#### AUDITS AND ACCOUNTS

Accountants of the Bureau completed audits and cost studies of 32 market agencies at the Fort Worth stockyards which were in progress at the close of the preceding year in preparation for a commission-rate hearing. The rate-case audit of the books and records of the Wichita stockyards, which had also been begun in the preceding year, was completed. In order to prepare for a hearing a supplemental detailed audit covering a 5-year period was made of the books and records of the Denver stockyards. Detailed audits and cost studies of six market agencies at Ogden and two at North Salt Lake were made in preparation for a joint hearing held at Ogden as to the reasonableness of rates and charges at the two markets.

Accountants also made special examinations at the stockyards located at Portland, Milwaukee, Denver, Sioux City, and Cleveland to study the effects of tariff changes at those markets. A special audit of the books and records of the St. Joseph stockyards was made in order to bring up to date the information necessary in connection with the hearing before the court as to whether the Secretary's order prescribing stockyard rates and charges should be set aside. In addition, accountants of the Bureau made 26 financial and trade-practice audits of the books and records of stockyard companies and market agencies and examined the books of 62 commission firms, dealers, and order buyers at various markets to determine their solvency. The force which had been engaged in the investigation of alleged price fixing by packers in certain of the Southern States completed this work during the year.

#### SUMMARIES OF REPORTS

Information compiled from the annual reports received from packers, stockyard companies, market agencies, and dealers is shown in tables 13 to 18, inclusive. The various reports cover business during the calendar year, with a few exceptions, which are on the basis of the fiscal year.

TABLE 13.—*Financial results of operations during 1934 for 851 packers subject to the Packers and Stockyards Act, grouped according to federally and nonfederally inspected slaughtering and nonslaughtering concerns*

Group	Concerns	Average net worth <sup>1</sup>	Net sales	Net gain
	Number	Dollars	Dollars	Dollars
Federally inspected slaughterers.....	206	676, 815, 838	2, 094, 311, 547	27, 743, 187
Nonfederally inspected slaughterers.....	402	49, 221, 827	190, 666, 795	1, 810, 644
Nonslaughterers <sup>2</sup> .....	243	156, 534, 220	258, 032, 720	9, 724, 875
Total.....	851	882, 571, 885	2, 543, 011, 062	39, 278, 706

<sup>1</sup> These figures represent the numerical average of the total net worth of reporting concerns at the beginning and end of their fiscal years.

<sup>2</sup> This group includes concerns which also handle commodities other than meat food products.

In addition to the complete reports from 851 packing concerns, financial details, lacking in some respects, were received from 10 other packers for the year 1934.

TABLE 14.—*Comparison of the operations of packers subject to the Packers and Stockyards Act, 1930-34*

Item	1930 (945 concerns)	1931 (927 concerns)	1932 (868 concerns)	1933 (871 concerns)	1934 (851 concerns)
Average net worth <sup>1</sup> .....	\$1, 058, 940, 521	\$1, 057, 166, 076	\$941, 046, 982	\$921, 602, 012	\$882, 571, 885
Total income.....	4, 023, 493, 741	3, 070, 743, 390	2, 204, 146, 322	2, 096, 484, 225	2, 556, 583, 329
Total expenses.....	3, 973, 497, 594	3, 083, 939, 372	2, 212, 033, 156	2, 062, 288, 906	2, 517, 304, 623
Net gain or loss <sup>2</sup> .....	+49, 996, 147	-13, 195, 982	-7, 886, 834	+34, 195, 319	+39, 278, 706
Percentage of gain or loss to net worth <sup>2</sup> .....	+4. 72	-1. 25	-0. 84	+3. 71	+4. 45

<sup>1</sup> These figures represent the average of the total net worth of all reporting concerns at the beginning and end of their fiscal years.

<sup>2</sup> Plus (+) denotes gain, minus (-) denotes loss.



TABLE 15.—*Summary of consolidated balance sheets of 92 posted stockyards at close of year 1934*<sup>1</sup>

Assets	Amount	Liabilities	Amount
Current.....	\$8,302,781	Current.....	\$2,506,084
Fixed.....	140,040,941	Other.....	40,106,380
Other.....	12,381,634	Capital and surplus.....	118,112,892
Total.....	160,725,356	Total.....	160,725,356

<sup>1</sup> 2 yards deposited, 16 yards posted too late for tabulation, reports from 1 yard waived, and reports from 2 yards not requested for year 1934.

A summary of consolidated profit and loss statements of 92 posted stockyards for the year 1934<sup>1</sup> follows:

<b>Income:</b>		
Yardage.....		\$12,995,810
Feed sales.....		8,353,849
Loading and unloading.....		1,512,728
Rent.....		1,782,193
Miscellaneous operations.....		6,645,793
Gross operating income.....		31,290,373
<b>Expenses:</b>		
Salaries and wages.....		6,281,377
Cost of sales—feed.....		4,704,810
Depreciation.....		2,032,469
Taxes (excluding Federal income tax).....		1,345,274
Miscellaneous operating expenses.....		8,838,281
Total operating expenses.....		23,202,214
Net operating profit.....		8,088,159
Other income.....		438,420
Total.....		8,526,579
Deductions from income.....		1,665,850
Net profit.....		6,860,729

<sup>1</sup> 2 yards deposited, 16 yards posted too late for tabulation, reports from 1 yard waived, and reports from 2 yards not requested for year 1934.

TABLE 16.—*Summary of reports from stockyard companies subject to the Packers and Stockyards Act, 1930-34*

Item	1930 (70 concerns)	1931 (67 concerns)	1932 (80 concerns)	1933 (82 concerns)	1934 (92 concerns)
Total average net worth.....	\$122,258,111	\$120,874,011	\$120,391,889	\$118,196,617	\$117,327,650
Gross income.....	30,646,729	27,791,967	23,812,509	24,649,150	31,728,793
Net gain.....	7,069,624	6,584,478	4,563,510	5,471,264	6,860,729
Percentage of gain to net worth.....	5.78	5.45	3.79	4.63	5.85

## LIVESTOCK COMMISSION AGENCIES

Number and class of market agencies reporting in 1934 follow:

Old-line agencies.....	650
Cooperative agencies.....	43
Horse and mule agencies.....	12
Total.....	705

TABLE 17.—*Summary of consolidated operating statements of livestock commission agencies, 1932-34*

Item	1932 (713 agencies)	1933 (700 agencies)	1934 (705 agencies)
Total commissions earned.....	\$18,460,190	\$19,178,231	<sup>1</sup> \$18,701,543
Total expenses (exclusive of owners' salaries).....	14,114,122	13,646,983	13,572,801
Net operating profit.....	4,346,068	5,531,248	5,128,742
Other income.....	747,082	600,109	671,145
Other expenses.....	10,222	20,636	38,680
Return to owners.....	5,082,928	6,110,721	15,761,207

<sup>1</sup> Does not include \$190,108.83 impounded commissions reported.

TABLE 18.—*Summary of consolidated profit and loss statements of 775 traders on 43 markets for 1934*<sup>1</sup>

Item	Dockage <sup>2</sup>	Animals handled	Weight	Amount
Cattle:				
579 traders on 38 markets:	<i>Pounds</i>	<i>Number</i>	<i>Pounds</i>	<i>Dollars</i>
Selling data.....		3,541,335	1,890,312,240	82,972,693
Cost data.....		3,539,499	1,884,855,631	79,127,139
Sheep:				
76 traders on 31 markets:				
Selling data.....		1,412,427	91,953,967	6,399,644
Cost data.....		1,414,039	92,677,143	6,046,991
Horses and mules:				
9 traders on 5 markets:				
Selling data.....		43,442		4,823,679
Cost data.....		43,327		4,440,935
Hogs:				
179 traders on 34 markets:				
Selling data.....	2,544,030	5,115,288	978,872,207	45,991,939
Cost data.....	2,796,905	5,112,193	978,121,448	44,531,641
All species:				
775 traders on 43 markets:				
Selling price.....				140,187,955
Cost price.....				134,146,706
Gross trading profit.....				6,041,249
Clearance commissions received.....				60,234
Other income.....				313,689
Total earnings.....				6,415,172
Expenses:				
Salaries and wages (other than owners').....				985,235
Clearance commissions paid.....				510,512
Feed.....				1,201,940
Yardage.....				141,225
Other expenses.....				1,342,259
Total expenses.....				4,181,171
Return to owners.....				2,234,001

<sup>1</sup> Does not include traders who were engaged also in order-buying business. Some of the traders handled more than 1 species.

<sup>2</sup> Represents deduction in weight at time of sale because of quality or condition of the animal. This practice applies only to hogs.

#### CONTROL OF INTERSTATE TRANSPORTATION OF LIVESTOCK

In the supervision of the interstate transportation of livestock to prevent the spread of animal diseases, Bureau inspectors at 49 stockyards in 47 cities inspected 25,285,814 cattle and 25,308,644 sheep, of which 2,044 cattle and 210,048 sheep were dipped under supervision to comply with the regulations of the Department and the various States to which they were destined. The number of swine inspected was 24,239,056, of which 290,519 were immunized and disinfected against hog cholera under Bureau supervision for distribution for feeding and breeding purposes.

Efforts were continued to minimize losses among stocker and feeder cattle and sheep on account of infectious disease. Divisions of public stockyards in which such livestock were handled were cleaned and disinfected under Bureau supervision. There were received at Bureau stations during the year 9,249 cars carrying animals affected with communicable diseases. Under Department regulations or on request of Canadian Government, State, and railroad officials, 15,587 cars were cleaned and disinfected under the supervision of Bureau employees.

Experienced veterinary inspectors at public stockyards continued to give particular attention to the inspection of all ruminants and swine for foot-and-mouth disease, no case of which was found.

Bureau employees at public stockyards devoted much time expediting the movement of reactors to the tests for tuberculosis and Bang's disease through the yards to slaughtering establishments.



## ENFORCEMENT OF TRANSPORTATION AND QUARANTINE LAWS

In the administration of the 28-hour law many improvements were made in the facilities for feeding, watering, and resting livestock while in transit; 399 alleged violations of the 28-hour law were reported to the Bureau. The Bureau transmitted 176 apparent violations to the Solicitor for presentation to the Attorney General. Penalties amounting to \$10,250 were imposed in cases decided in favor of the Government. There were five employees who devoted most of their time to this work, but the evidence was collected and the reports prepared largely by employees stationed at public stockyards whose time was devoted chiefly to other lines of work.

Eighty alleged violations of the quarantine laws were reported to the Bureau, and 65 cases of alleged violations were reported to the Solicitor for prosecution. In cases decided in favor of the Government, fines imposed amounted to \$3,000.

## PATHOLOGICAL DIVISION

Under the direction of Harry W. Schoening, Chief, the Pathological Division has followed the usual line of scientific investigation of the diseases of domestic animals and birds, the poisoning of livestock by plants, and the examination of viruses, serums, and other biological products used in the treatment and prevention of diseases of domestic animals.

### DIAGNOSIS AND CONTROL OF DISEASES

Cooperative work for the control and eradication of glanders in the various States was continued. The complement-fixation test was applied to 48 samples of blood serum from animals suspected of being affected with or exposed to the disease. Three positive reactions were obtained.

Samples of blood from 305 horses, in the area in which dourine is present or suspected, were subjected to the complement-fixation test. Ten positive reactions were obtained. Blood-serum samples from seven horses offered for import were subjected to the complement-fixation test for glanders and trypanosomiasis before the animals were admitted. No positive reactions were obtained.

Eighty brain specimens from suspected cases of rabies were received and subjected to laboratory examination. Of these, 56 were from dogs, of which only 1 was positive. In 20 cats, 1 cow, 1 skunk, and 2 rats no evidence of rabies was found. The one positive case was in a dog which came into the District of Columbia from Texas on July 4, 1934, and developed symptoms of rabies on August 3, 1934, dying of dumb rabies 5 days later. Examination of the brain disclosed typical Negri bodies, and the diagnosis was further substantiated by rabbit inoculation. Rabies was prevalent in the section from which the dog came, and since no case of rabies has been positively diagnosed in the District of Columbia since December 1931, it seems very probable that the infection was acquired in Texas. This case illustrates the danger of spreading rabies by movement of dogs from one State to another.

During the year, 112 stock cultures were carried in the Division's collection, and 231 subcultures of organisms were supplied to various laboratories for use in preparation of biologies and scientific investigation.

### TESTING BIOLOGICAL PRODUCTS

In cooperation with the Division of Virus-Serum Control in the enforcement of the Virus-Serum-Toxin Act, the Pathological Division continued the examination of samples of biological products and cultures intended for use in making such products. During the year, 107 representative samples of serums, vaccines, bacterins, aggressins, filtrates, toxoids, and antitoxins were tested for purity, potency, and safety. Of these, 90 were approved and 17 were found to be unsatisfactory. Two hundred and seventy-one cultures were examined for trueness to type, of which 197 were approved and 74 were found to be unsuitable for the preparation of veterinary biologies.

### BOVINE MASTITIS

Investigation of bovine mastitis has been carried on, continuing work begun several years ago. The colostrum from each quarter of 36 first-calf heifers from a herd containing mastitis infection was examined bacteriologically. No

streptococci were found in the colostrum from 21; of the remaining 15, types resembling *Streptococcus fecalis* were found in samples from one or more quarters of 11 animals, *S. mitis* in 2, *S. salivarius* in 1, and an unknown species in the remaining 1. Upon reexamination within a few weeks, no streptococci were found in the udder secretion of 9 animals, *S. fecalis* had apparently persisted in 1 heifer, and 2 other animals had become infected with *S. agalactiae* in 2 weeks and 1 month, respectively.

Further experimentation concerning the transmission of *S. agalactiae* was carried out. Six pregnant heifers, obtained for the purpose, calved at the Bureau's Experiment Station. Within a week after parturition these animals were placed in the milking line, and each was milked after one or more cows which were affected with marked cases of chronic mastitis due to *S. agalactiae*. Two of these cows had become infected under field conditions and when their usefulness was ended they were replaced by others in which the disease had been induced artificially. Exposure was made with a small portable milking machine and stripping by hand, in addition. The animals were in constant association with one another. No attempt was made to clean or disinfect the machine or hands between animals. Although the experiment extended over a period of 10 months, transmission of infection did not occur.

In nine cows suffering from severe chronic mastitis in which the presence of streptococci was definitely established in one or more quarters of the udder, an attempt was made to determine whether *S. agalactiae* might be present in the blood. Although large samples (200 to 300 cc) of blood were cultured, no streptococci were recovered in any case.

#### INFECTIOUS EQUINE ENCEPHALOMYELITIS

A strain of encephalomyelitis virus was recovered from a horse which died during the 1934 outbreak in South Dakota. This virus was found to be a western type similar to strains obtained from the 1932 and 1933 South Dakota outbreaks. Virus was recovered also from the 1934 eastern outbreak in New Jersey, Delaware, Maryland, and Virginia. All these strains proved to be of eastern type.

It has been observed that the original South Dakota virus (1932) has gradually acquired increasing virulence by passage through a series of guinea pigs injected intracerebrally. The increased virulence has not been accompanied by type modification and the pathogenicity for horses has been maintained.

The wide range of species which can be infected artificially with eastern virus includes the following animals: White mice, white rats, guinea pigs, rabbits, European hedgehog, domestic cat, dog, pig, sheep, goat, calf, pigeon, hen, duck, horse, and mule. The opossum resisted infection (intracerebral) with either eastern or western type. Western virus failed to infect the European hedgehog, domestic cat, dog, pig, and sheep, but proved pathogenic for the other animals mentioned, although the hen and duck appeared to be less susceptible to western virus than to the eastern.

In cooperation with the Bureau of Entomology and Plant Quarantine, repeated attempts were made to transmit the eastern-virus infection by means of the mosquito, *Aedes aegypti*. Success was obtained in one instance. This was in contrast with the regularity with which western virus may be so transmitted. In repeated trials with the same species of mosquito, no evidence was obtained to show that infection is carried from the adult through the eggs to the succeeding generation. In testing the infectivity of individual groups of mosquitoes, the inoculation of guinea-pig foot pads appeared to be preferable to inoculations into the skin of other parts of the body. A few guinea pigs exposed to the bites or the inoculation of infected mosquitoes failed to develop clinical signs of the disease, but were shown later to be immune. A similar observation of latent infection was made in the case of a horse exposed to the bites of western-virus-infected mosquitoes. Although the animal was definitely infected, as evidenced by the appearance of virus in the blood on the fourth day after exposure and its persistence up to the seventh day, no clinical signs of disease developed. Periodic tests of the animal's blood during the succeeding 9 months have failed to show the presence of demonstrable virus.

Conjunctival instillation of eastern virus, together with implantation of sharp, fine sand as a scarifying agent, did not result in infection in the horse, which was subsequently shown to be susceptible to intracerebral inoculation. An entire horse brain containing eastern virus was consumed within a week by a horse whose tongue was repeatedly scarified. No apparent infection occurred,



but the animal proved to be immune upon exposure by intracranial inoculation. No cross immunity was found to exist in horses alternately exposed to representative western and eastern strains of virus.

In a search for a suitable means of exposure of horses in immunity tests, it was found that the intralingual inoculation of infective guinea-pig pads, taken preferably 24 hours after inoculation from the third-passage animals, resulted in almost as high a percentage of infection as by intracerebral inoculation. This method of exposure was used in controlled experiments to evaluate the efficacy of formalized brain-tissue vaccine in which no active virus was demonstrable. Evidence that such a product conferred a certain degree of immunity was obtained. The results of field trials likewise suggest that the vaccine has some prophylactic value.

#### ALKALI DISEASE

There exists in certain areas in the Great Plains a disease of livestock known locally as "alkali disease." Clinically, the disease manifests itself in the susceptible animals (horses, cattle, swine) by a loss of hair and marked deformities in the growth of the hoof. Many of the affected animals die or are of little value after recovery.

This problem has been a subject of investigation by several bureaus of the Department, in cooperation with the South Dakota State College of Agriculture, and evidence had been obtained to indicate that the condition is brought about by the presence of selenium in the vegetation in certain areas of the affected territory.

Feeding experiments with corn grown in the affected area have produced the clinical picture of the condition in swine at the Bureau's Experiment Station at Bethesda, Md. Likewise experiments with swine which were fed a ration to which inorganic selenium had been added in various proportions resulted in lesions similar to those observed in animals in the affected territory.

#### MISCELLANEOUS DISEASES

Investigations of infectious anemia, or swamp fever, extending over a period of 17 years, have furnished information concerning the disease in this country. The cause is a filtrable virus which was transmitted experimentally through biting insects but not by feed nor contact. Susceptibility was found to be limited to equines. Aside from actual inoculation of horses, the studies failed to disclose diagnostic tests of value; diagnosis must depend on clinical symptoms and anatomical changes. Losses are occasioned by the death of infected animals, in many cases, as well as by inability to perform normal work. Means of combating the disease are abundant good feed, sanitary environment, and the elimination of all debilitating influences.

Studies on the possible transmission of rabies virus through the milk were undertaken. It was found that cattle and swine could be infected with regularity by the intralingual injection of rabies street virus. Two milking cows were inoculated with the virus in that manner. The milk of these cows was fed daily to 4 pigs and 1 calf from the time the cows were inoculated until their death—in 1 animal, 17 days; in the other, 18 days. There was a decrease in milk production several days before the cows died. Inoculations of samples of milk taken at various times and of udder tissue after death into rabbits failed to reveal the presence of rabies virus. Likewise, the 4 pigs and the calf have remained healthy after more than 6 months.

Studies on swine erysipelas were continued with special reference to observing dissociation phenomena of the causative organism on artificial media. Under certain conditions rough and smooth colonies could be recognized, and the characteristics are apparently retained for a considerable time. Antigens for the agglutination test prepared from smooth colonies appeared to be superior from the standpoint of specificity and stability to antigens derived from rough-type colonies.

Investigation of two outbreaks of disease on the same premises, in swine weighing from 50 to 125 pounds and that had been immunized against hog cholera, each outbreak following shipment with an interval of 14 months, indicated the trouble to be caused by *Salmonella suipestifer*. In both outbreaks the lesions were similar to those seen in hog cholera. In the first outbreak hog cholera was eliminated by filtration experiments, and the *S. suipestifer* that was obtained from the various tissues was found to be

highly pathogenic for swine, producing lesions similar to those in hogs that died from the natural disease.

*Corynebacterium pyogenes* was found to be the cause of a disease in a herd of swine in which a variety of symptoms and anatomical changes were observed. Affected animals showed one or more of the following symptoms: Stiffness of gait, lameness, progressive cachexia especially after farrowing, paralysis of the hind quarters, pneumonia, swelling of one or more joints, and abscesses, either large or small, occurring anywhere about the body. The anatomical changes found on autopsy either singly or in combination were fibro-cartilaginous arthritis, suppurative arthritis, abscess formations in the subcutaneous tissues and in the body muscles, along the tendon sheaths, on the joint capsules, in the lungs, in body and visceral lymph glands, in the kidneys and the ureters, in the heart, and on the pericardium. In several instances extensive suppurative pneumonia of both lungs and suppurative pericarditis were noted. One animal presented a suppurative endometritis, suppurative nephritis, and suppurative inflammation and induration of the ureters. Rigid sanitary measures appeared to control the disease.

In cooperation with the Zoological Division, the studies reported last year on the use of ticks in the complement-fixation test for anaplasmosis were continued in an attempt to develop this test for the purpose of practical diagnosis of the infection.

A serious outbreak of the so-called "cornstalk disease" of horses occurred in several of the Central States during the fall, winter, and spring, and an opportunity was afforded through the Department of Animal Pathology and Hygiene of the University of Illinois to study the disease. Clinically, the affection was similar in many respects to that produced by the virus of encephalomyelitis, but examination of many brains from affected animals failed to reveal the presence of a virus or other infective agent which could be incriminated etiologically. The disease was associated with the feeding of corn which had been stunted by drought during the growing season and later affected by heavy rains. Much of the corn being fed was moldy, wormy, or otherwise damaged. Feeding some moldy corn-and-cob meal from the affected region, either in a dry state or after wetting and fermenting, failed to produce the disease in two horses. Pathologically the disease is an encephalomyelitis differing from the virus disease particularly in presenting greater degenerative changes often evidenced by areas of gross softening of the brain.

With the cooperation of stockmen and stockyards officials, the Bureau endeavored to ascertain the value of soda (sodium bicarbonate) as a preventive for shipping fever (hemorrhagic septicemia) of cattle. To evaluate the soda treatment, administered at the stockyards at the time of marketing, 2,175 cattle were treated and 1,949 were left untreated as controls. Reports from the purchasers of the treated cattle indicated that sickness developed in 10 animals and of these 4 died. Reports from the purchasers of the untreated animals showed that sickness developed in 13 animals and of these 5 died. In reports indicating sickness in 94 cattle, with death in 8, it could not be determined in which groups the sickness or deaths occurred. To evaluate the soda treatment when administered at the home premises after shipment from the marketing centers, reports were received on 5,959 treated cattle, in which group sickness developed in 394 and death in 19. In 14,580 cattle not treated at the home premises, sickness was reported in 261 and death in 12. Pending further evidence, the soda treatment, either at stockyards or after shipments are received on farms, thus appears to be of questionable effectiveness.

Bacteriological examination of 40 cervical lymph glands of swine in which abscesses of various sizes were found on post-mortem examination, in Federal meat inspection, resulted in finding streptococci in 18 instances, staphylococci in 6, a mixture of streptococci, staphylococci, and other unidentified organisms in 3, tubercle bacilli in 2, *Brucella* organisms (porcine) in 1. The remaining 10 were found to be sterile.

Three cases of primary actinomycosis of the peritoneum of young calves, approximately 8 weeks of age, have been studied at the pathological laboratory. There was striking similarity of the three cases with regard to the age of the calves and the location and general character of the gross lesions in each of the animals. The gross lesions consisted of numerous whitish nodules, varying in size from a millet seed to that of a pea or larger, scattered over the peritoneum in the region of the liver, spleen, and stomach. The histological picture was similar in all three cases, consisting of the usual granulation tissue seen in actinomycotic lesions in which could be seen the



colonies of actinomyces, surrounded by lymphoid and epithelioid cells. Occasional giant cells were noted. In the older lesions more extensive fibrous changes were seen with a tendency to calcification.

#### INVESTIGATIONS OF STOCK-POISONING PLANTS

During the year, various poisonous plants, substances, and subjects related to plant poisoning were under investigation. Noteworthy results were obtained in the following cases.

The range plant, *Asclepiodora decumbens*, was found to be toxic for horses. The vetch, *Astragalus flavus*, was toxic for both guinea pigs and sheep, and the dosage and symptoms of poisoning produced by the plant were determined. The quantity of selenium in the plant, as determined by the Bureau of Chemistry and Soils, was apparently sufficient to produce the results obtained in the experimental feedings.

Observations made during the year on bighead in sheep tended strongly to confirm former conclusions that two species of *Tetradymia* (*T. glabrata*, coal-oil weed, and *T. canescens inermis*, spineless horsebrush) were the most important single factors in the production of bighead in the areas visited in Utah and Idaho. Five out of 20 sheep fed *T. glabrata* and 2 out of 6 fed *T. canescens inermis* developed typical cases of bighead. In addition to the sheep developing bighead, practically all the other animals became ill and several died, the symptoms and lesions being identical to those exhibited by many sheep in every bad break of bighead.

Results of tests indicate that, as with the tall larkspur *Delphinium barbeyi*, *D. occidentale* becomes progressively less toxic as it grows older. A species of larkspur as yet undetermined received from Lemhi National Forest was found to be approximately as toxic as *D. barbeyi*.

Experimental feedings of the wild cherry, *Prunus melanocarpa*, showed that the presence of considerable water in the animals' stomachs at the time the cherry leaves are eaten markedly affects the quantity of leaves necessary to poison. This is of considerable interest as dense stands of cherry bushes sometimes grow near water places and serious losses from cherry-leaf poisoning have occurred in such localities.

A considerable number of experiments with guinea pigs to determine the possible effects of light on animals injected with fern extract (*Pteridium aquilinum*) were made, all with negative results.

A few feedings of sodium selenite were made in sheep as controls for feedings of *Astragalus flavus*. The symptoms and lesions produced by the selenite and the *Astragalus* were found to be very similar, if not identical. The toxicity of sodium selenite and sodium selenate was determined, the selenate being found to be more toxic than the selenite.

The hairy nightshade, *Solanum villosum*, was found to be not particularly toxic for sheep, at least under the conditions of the experiments.

A sample of Sudan grass hay from Wisconsin that was somewhat moist and moldy was found to be toxic for sheep. When dry it appeared to be much less toxic. As it did not show the presence of hydrocyanic acid, toxicity was apparently due to spoilage.

Specimens of arrowgrass, *Triglochin maritima*, growing in dry or relatively dry situations were found to be fully five times as toxic as those studied in 1925 and 1926. As little of the plant as 0.2 percent of the sheep's weight caused illness. Plants growing in standing water were found to be very slightly toxic. Doses up to 3 percent were given to sheep without visible effect. Plants that had been dried and kept in the laboratory for 6 months were found to have retained nearly their full toxicity, although material taken from an old haystack was nontoxic. The nitrite-thiosulphate combination, which had been used in cyanide poisoning, was found effective as a remedy in arrowgrass poisoning.

Sheep fed a plant known as false-hellebore, *Veratrum californicum*, were slightly poisoned by doses varying between 0.5 percent of fruit and 1.35 percent of flower heads and green fruit. The plant is obviously somewhat poisonous.

#### TOXICOLOGICAL INVESTIGATIONS

An extensive series of experiments were made, using cattle, sheep, and horses, in an effort to develop remedies for cyanide poisoning under practical conditions. Methylene blue, sodium nitrite, sodium thiosulphate, and sodium tetrathionate were tested singly and a combination of sodium nitrite and sodium

thiosulphate was developed which is most promising. The minimal lethal doses of sodium cyanide, potassium cyanide, and hydrocyanic acid were determined for cattle and sheep with accuracy.

Chemical studies of the lupine alkaloids were continued. The alkaloids of *Lupinus luteus* have been prepared in pure condition. From *L. sericeus* an alkaloid has been extracted that yields a crystalline hydrochloride. Alkaloids were extracted from two species of lupines from Idaho.

Chemical analyses of specimens of *Triglochin maritima* indicated that there is a considerable variation in the hydrocyanic acid content of this plant when grown under different conditions.

#### BRANCH LABORATORIES

##### BELTSVILLE

During the year 2,118 fowls, 5 rabbits, and 1 pigeon were necropsied. The two major causes of death were leucosis and respiratory disease. The losses during the year from pox and laryngotracheitis were greatly lessened by vaccination. In transmission experiments on leucosis it was found that the liver of affected birds was the best source of virus, with bone marrow and nerve tissue somewhat less rich in virus. The age (from 10 to 28 days) at which chicks are inoculated appeared to make no significant difference in the number of "takes" obtained.

##### BETHESDA

An experiment was reported to show that normal adult fowls associating with fowls infected with pullorum disease may acquire that disease. Observations on the immunization of fowls against infectious laryngotracheitis by bursal vaccination with the virus of the disease indicated that this procedure is effective.

Experiments to obtain effective disinfectants for poultry-feeding establishments were conducted, employing the virus of infectious laryngotracheitis as a criterion. Sodium orthophenylphenate, 1 percent, and sodium hydroxide, 2 percent, were found to be effective disinfecting solutions, without objectionable odor or flavor production. The former, however, was effective only at 60° F. or higher.

##### CHICAGO

The branch pathological laboratory at Chicago, Ill., was engaged, as previously, in investigating diseases of meat food animals and aiding particularly the Federal meat-inspection service by rendering diagnoses of obscure conditions. During the year a number of specimens of rumens from cattle were examined and the mucosa found involved in the pathological process known as the epithelial pearl—a nodular formation composed of concentric rings of necrotic and cornified epithelial cells.

##### DENVER

There were 8,542 specimens received and examined at the Denver branch pathological laboratory. Of 4,018 cattle to which the agglutination test for Bang's disease was applied, approximately 67.5 percent were negative, 24 percent positive, and 8.5 percent suspicious.

Of chicken specimens examined, 367 chicks had pullorum disease; 122 range paralysis in its various forms; 100 had dietetic disorders; 90 had roup or bronchitis; 48 had coccidiosis; and 34 adult fowls gave positive tests for pullorum disease.

#### DIVISION OF TICK ERADICATION AND SPECIAL DISEASES

The Division of Tick Eradication and Special Diseases, under the direction of W. M. MacKellar, chief, conducted the Bureau's cooperative work in the eradication of the cattle-fever tick and in hog-cholera control.

##### TICK ERADICATION

The eradication of the cattle-fever tick was continued in cooperation with State and county officials and southern cattle owners. At the close of the fiscal year 370 veterinarians and other Bureau employees were working in cooperation with 470 State and 20 county employees engaged in this project. Under their supervision 27,550,801 inspections or dippings of cattle and 2,734,249



inspections or dippings of horses and mules were conducted. More than 12,000 dipping vats were used in the official dippings.

The following areas were released from Federal quarantine as a result of tick-eradication activities: The remainder of 3 counties in Florida; 12 parishes, remainder of 3 parishes, and parts of 2 parishes in Louisiana; and part of 1 county in Texas. The aggregate area of this released territory is 12,852 square miles. No areas were requarantined during the year. At the close of the fiscal year the area remaining under Federal quarantine in continental United States had been reduced to 9 percent of its original size and is now confined to parts of Florida, Louisiana, and Texas. Table 19 shows the progress in tick eradication since its beginning in 1906 and gives the status of the work at the close of the fiscal year.

TABLE 19.—*Tick-eradication results, July 1, 1906, to June 30, 1935*

State	Counties quarantined on—		Counties released to June 30, 1935	Released counties tick free on Nov. 1—			
	July 1, 1906	June 30, 1935		1931	1932	1933	1934
Alabama.....	67	0	67	67	67	66	67
Arkansas.....	75	0	75	55	60	64	63
California.....	15	0	15	15	15	15	15
Florida.....	67	11	56	41	46	44	48
Georgia.....	158	0	158	158	157	158	158
Kentucky.....	2	0	2	2	2	2	2
Louisiana.....	64	24	40	17	10	14	16
Mississippi.....	82	0	82	77	77	79	74
Missouri.....	4	0	4	4	4	4	4
North Carolina.....	73	0	73	73	73	73	73
Oklahoma.....	61	0	61	61	61	60	61
South Carolina.....	46	0	46	46	46	46	46
Tennessee.....	42	0	42	42	42	42	42
Texas.....	198	36	162	113	126	135	130
Virginia.....	31	0	31	30	31	31	31
Total.....	985	71	914	801	817	833	830

#### FEDERAL EMERGENCY RELIEF ADMINISTRATION ASSISTANCE

During the year this project received valuable assistance from the Federal Emergency Relief Administration agencies in Arkansas, Florida, Louisiana, and Texas. Men from the relief rolls of these States were employed for an aggregate of 368,259 man-hours on various activities connected with this work, such as building, repairing, cleaning, and filling dipping vats, building drift fences, assisting in dipping, and range riding. This assistance was a very material help to many areas where State appropriations for the work were inadequate.

#### MOVEMENT FROM QUARANTINED AREAS

In the enforcement of Department regulations governing the interstate movement of cattle and horses from the areas quarantined for splenic, southern, or tick fever, 180,279 cattle were inspected, or dipped and inspected, for which 2,996 certificates were issued authorizing their interstate movement as noninfectious. Horses and mules to the number of 5,815 were also inspected in the quarantined areas, and 765 certificates were issued authorizing their movement from such areas. In connection with these movements 1,254 cars were cleaned and disinfected.

#### HOG-CHOLERA CONTROL

During the year 30 veterinarians, except while they were assigned to drought-relief work and other emergency activities, were employed in investigating and controlling outbreaks of hog cholera and allied swine diseases. Through visits and attendance at meetings Bureau veterinarians had the opportunity to discuss their work with several thousand farmers, as well as interviewing veterinarians, State officials, and others interested in the suppression of hog cholera. Educational work on this project was continued by the veterinarians, who attended 233 meetings, at which there was an attendance of 19,953 persons. Demonstrations in the use and efficacy of the serum treatment were given in the treatment of 19,793 hogs.

During the year there were reported to Bureau veterinarians 2,256 outbreaks of hog cholera, which is 1,867 less than those of the previous year. This decrease cannot be considered as indicating a corresponding reduction in the prevalence of the disease, since herds, in general, were of smaller size than during previous years and losses from the average outbreak were consequently less than usual. Table 20 summarizes the activities of the year.

TABLE 20.—Summary of hog-cholera-control work, fiscal year 1935

State	Meetings		Interviews	Post-mortem examinations	Hogs treated in demonstrations	Outbreaks reported to Bureau veterinarians
	Number	Attendance				
Alabama.....	3	70	2,150	1	118	6
Florida.....	0	0	934	3	3,585	27
Georgia.....	0	0	802	6	418	48
Illinois.....	8	815	4,637	367	11	282
Indiana.....	9	680	1,813	50	0	107
Iowa.....	30	2,565	4,096	195	275	485
Kansas.....	0	0	551	3	0	0
Kentucky.....	17	549	4,833	103	0	86
Louisiana.....	1	30	378	13	2,230	58
Maryland.....	94	8,969	7,422	128	364	290
Michigan.....	0	0	364	12	352	119
Mississippi.....	3	81	409	0	411	0
Nebraska.....	0	0	5	5	0	0
North Carolina.....	10	2,187	906	82	2,246	56
Ohio.....	15	1,039	927	21	0	140
Oklahoma.....	1	500	1,163	11	0	29
Oregon.....	3	70	239	0	0	4
South Carolina.....	0	0	1,099	6	7,596	44
South Dakota.....	0	0	139	8	16	8
Tennessee.....	3	606	1,920	52	1,269	322
Texas.....	0	0	496	1	0	11
Virginia.....	16	1,175	4,535	68	0	16
Washington.....	18	502	1,293	24	70	18
Wisconsin.....	2	115	639	28	832	100
Total.....	233	19,953	41,750	1,187	19,793	2,256

## TUBERCULOSIS ERADICATION DIVISION

The work of eradicating tuberculosis from livestock was continued in co-operation with the various States, counties, and livestock owners. Much more work was done in this project than during any previous year, owing to the availability of additional Federal funds for it. Also, assistance was given in the emergency project conducted in connection with Bang's disease in cattle and mastitis in cows. This division was directed by A. E. Wight, chief, and the Bureau veterinarians in charge of the various stations.

### BOVINE TUBERCULOSIS

The greater part of the work consisted in the testing of cattle under the area plan. Altogether, 25,237,532 tuberculin tests were applied to cattle. The percentage of reactors was 1.5, the same as for the previous year.

The Federal force of veterinarians was used to a considerable extent in supervising field work performed by a large number of other veterinarians employed for a temporary period with emergency funds. The work was conducted from 44 different field stations. The State authorities employed an average of about 275 veterinarians throughout the year, and the counties employed about 210 veterinarians on full time. An average of 756 temporary veterinarians was employed during the year, together with about 500 local laymen to assist them.

The emergency fund for tuberculosis work for a period beginning July 1, 1934, and ending December 1, 1935, was \$13,750,000. This amount was available for indemnity and operating expenses. The Federal indemnity payment with emergency funds could be made without requiring the States or counties to make a similar payment; hence it was possible to advance the work to a great extent in areas where no State or county funds were available. The regular Federal appropriation for tuberculosis work for the fiscal year 1935 was \$4,042,179, of which \$3,000,000 was for indemnity and the remainder for operating expenses. Combined State and county appropriations were approximately



\$9,000,000 during that period. The maximum Federal payment for grade cattle continued to be \$20, until June 10, 1935, when it was advanced to \$25. No change was made in the maximum payment of \$50 for pure-bred cattle. The salvage received for reactors by the owners was low early in the fiscal year on account of low prices for cattle, but in May it reached \$22.33, and in June, \$24.77. The average for the year was \$15.19. The average appraised value of reactors was \$57.55. Of the total number of reactors on which Federal payment was made, 4 percent were purebred registered cattle. The average Federal payment was \$18.70, and the average State payment \$15.87. Approximately \$7,000,000 of Federal funds was used for indemnity, and about \$6,000,000 of State funds was used.

The results of tests of cattle for Johne's disease or paratuberculosis, made with either johnin or avian tuberculin, showed that this disease exists to a slight degree in 11 States; 154 cattle, or 5.4 percent of the total number tested, were condemned on account of this disease.

## RESULTS OF BIENNIAL SURVEY

The eighth survey to determine the approximate extent of bovine tuberculosis in the various counties in the United States was completed May 1, 1935. It indicated that the approximate degree of infection in tuberculosis among cattle had been reduced to 0.6 percent. The first survey, made in 1922, indicated that about 4 percent of all the cattle in this country were affected with tuberculosis, and in some of the States the extent of the infection was very much higher. In the most recent survey, it was found that in only 9 counties in 2 States was the degree of infection more than 7 percent, and in only 4 counties in 2 States was the infection more than 15 percent.

## PROGRESS IN TUBERCULIN TESTING OF CATTLE

At the end of the fiscal year 5,590,863 herds, containing 48,768,627 cattle, were under supervision for the eradication of tuberculosis. In 43 States more than 50 percent of the cattle were under supervision. As an indication of the continued interest in the work throughout the United States, the records showed a waiting list of approximately 1,650,000 cattle. Table 21 shows that from 1917 to 1935, inclusive, 3,302,561 reactors were removed from the cattle herds of this country.

TABLE 21.—*Progress of tuberculin testing under accredited-herd and area plans, 1917-35*

Year ended June 30—	Cattle tested					Modified accredited counties	Herds accredited <sup>1</sup>	Herds passed one test <sup>1</sup>	Herds under supervision <sup>1</sup>
	Accredited-herd plan	Area plan	Total	Reactors found and removed	Percentage of reactors				
	Number	Number	Number	Number		Number	Number	Number	Number
1917.....	20,101	.....	20,101	645	3.2	.....	.....	.....	.....
1918.....	134,143	.....	134,143	6,544	4.9	.....	204	883	.....
1919.....	329,878	.....	329,878	13,528	4.1	.....	578	5,652	.....
1920.....	700,670	.....	700,670	28,709	4.1	.....	2,588	10,064	.....
1921.....	1,366,358	.....	1,366,358	53,768	3.9	.....	4,831	33,215	71,806
1922.....	1,722,209	2,662,027	2,384,236	82,569	3.5	.....	8,015	111,719	140,376
1923.....	1,695,662	1,765,187	3,460,849	113,844	3.3	.....	12,310	150,748	187,915
1924.....	1,865,863	3,446,501	5,312,364	171,559	3.2	.....	19,747	216,737	305,809
1925.....	2,008,526	4,991,592	7,000,028	214,491	3.1	51	24,110	392,740	414,620
1926.....	1,989,048	6,651,732	8,650,780	323,084	3.7	109	24,009	382,674	435,840
1927.....	2,522,791	7,177,385	9,700,176	285,361	2.9	149	34,084	229,086	261,148
1928.....	2,589,844	8,691,646	11,281,490	262,113	2.3	180	38,880	427,595	473,218
1929.....	2,853,633	8,830,087	11,683,720	206,764	1.8	213	1,639	249,420	281,323
1930.....	2,953,350	9,892,521	12,845,871	216,932	1.7	236	11,863	227,921	347,448
1931.....	3,086,403	10,695,870	13,782,273	203,778	1.5	247	26,259	350,735	356,916
1932.....	3,131,426	10,312,131	13,443,557	254,785	1.9	220	18,049	262,988	303,832
1933.....	2,980,526	10,093,368	13,073,894	255,096	2.0	183	19,701	337,730	346,394
1934.....	2,826,257	12,293,506	15,119,763	232,368	1.5	189	31,460	342,262	387,969
1935.....	2,716,292	22,521,240	25,237,532	376,623	1.5	613	13,128	1,324,643	1,276,249
<b>Total.....</b>	<b>37,492,980</b>	<b>118,034,703</b>	<b>155,527,683</b>	<b>3,302,561</b>	<b>2.1</b>	<b>2,428</b>	<b>238,937</b>	<b>5,056,812</b>	<b>5,590,863</b>

<sup>1</sup> The figures in these columns represent net increases at the close of each year.

<sup>2</sup> Test made during 6 months.

<sup>3</sup> Represents decrease from figures for previous year.

<sup>4</sup> Not including part of 4 counties and 83 towns.

## ERADICATION OF TUBERCULOSIS FROM AREAS

The work under the area plan was greatly enlarged during the year. Approximately 89 percent of all the cattle tested were handled under this plan. Tuberculin testing of all cattle was completed in the following States: Illinois, Virginia, Oregon, Minnesota, Kansas, Florida, Missouri, and Arkansas. The total number of States in the modified accredited area on June 30, 1935, was 22.

At the same time, the modified accredited area included 2,428 counties, parts of 4 other counties, and 83 towns. Of all the counties in the United States, 79.1 percent were in the modified accredited area at the end of the fiscal year and about 90 percent were either in the modified area or engaged in the area plan of testing. Table 22 shows the status of this area work on June 30, 1935.

TABLE 22.—*Status of tuberculosis eradication from county areas at close of fiscal year 1935*

State <sup>1</sup>	Total counties in State <sup>1</sup>	Counties completing one or more tests of all cattle <sup>1</sup>	Counties intensively engaged in testing	Total counties engaged <sup>1</sup>	Modified accredited areas <sup>1</sup>
Alabama.....	67	40	9	49	37
Arizona.....	14	2	12	14	2
Arkansas.....	75	75	0	75	75
California.....	58	8	30	38	7
Colorado.....	63	57	6	63	57
Connecticut.....	8	4	2	6	4
Delaware.....	3	2	0	2	2
District of Columbia.....	1	1	0	1	1
Florida.....	67	67	0	67	67
Georgia.....	159	121	29	150	120
Idaho.....	44	44	0	44	44
Illinois.....	102	102	0	102	102
Indiana.....	92	92	0	92	92
Iowa.....	99	91	8	99	90
Kansas.....	105	105	0	105	105
Kentucky.....	120	120	0	120	120
Louisiana.....	64	23	2	25	23
Maine.....	16	16	0	16	16
Maryland.....	23	12	7	19	6
Massachusetts.....	14	11	3	14	11
Michigan.....	83	83	0	83	83
Minnesota.....	87	87	0	87	87
Mississippi.....	82	41	3	44	36
Missouri.....	114	114	0	114	114
Montana.....	56	2 31	2 18	54	2 34
Nebraska.....	92	52	20	72	50
Nevada.....	17	17	0	17	17
New Hampshire.....	10	10	0	10	10
New Jersey.....	21	2 6	2 13	21	2 6
New Mexico.....	31	23	8	31	23
New York.....	62	40	22	62	32
North Carolina.....	100	100	0	100	100
North Dakota.....	53	53	0	53	53
Ohio.....	88	58	0	88	88
Oklahoma.....	77	59	5	64	59
Oregon.....	36	36	0	36	36
Pennsylvania.....	67	56	11	67	56
Rhode Island.....	5	3	2	5	3
South Carolina.....	46	42	2	44	42
South Dakota.....	69	26	2	28	0
Tennessee.....	95	85	6	91	85
Texas.....	254	119	25	144	119
Utah.....	29	29	0	29	29
Vermont.....	14	2 2	3 11	14	3 3
Virginia.....	100	100	0	100	100
Washington.....	39	39	0	39	39
West Virginia.....	55	55	0	55	55
Wisconsin.....	71	71	0	71	71
Wyoming.....	23	17	6	23	17
Total.....	3,071	4 2,481	4 262	2,747	4 2,428

<sup>1</sup> Including District of Columbia.

<sup>2</sup> Not including part of 2 counties.

<sup>3</sup> Not including 83 towns.

<sup>4</sup> Not including part of 4 counties and 83 towns.



## TUBERCULOSIS FROM POULTRY AND SWINE

The control and eradication of the avian (fowl) type of tuberculosis, which also is readily transmissible to swine, have been a part of the regular program for the eradication of tuberculosis from livestock.

The survey of farm poultry flocks, begun several years ago, in connection with the testing of cattle for tuberculosis, was continued, and during the year about 345,000 flocks of poultry, containing about 26,000,000 fowls, in 21 States, were observed. As a result of such observations, the disease was reported on 7,508 farms. This branch of the work was conducted with little additional cost to the Federal and State departments, because the veterinarians who did the work were engaged in the tuberculin testing of cattle.

As a separate additional project 10 Bureau veterinarians were assigned to the eradication of avian tuberculosis in the Midwestern and North Central States. The employees engaged in these activities visited about 28,000 farms and observed approximately 2,297,405 fowls. Tuberculosis was reported on 2,450 of these farms. Literature and other information on means of eliminating the disease from poultry and swine were furnished the owners, who were also invited to visit meetings where avian tuberculosis was discussed.

## REGULATIONS OF INTERSTATE MOVEMENT OF CATTLE

Under the provisions of regulation 7 of B. A. I. Order 309, approved veterinary practitioners throughout the 48 States continued to conduct most of the tuberculin testing for interstate shipment. On June 30, 1935, there were 10,599 veterinarians on the approved list. These men tested for interstate shipment about 31,000 lots of cattle, containing about 370,000 cattle, of which 0.09 percent reacted to the test. This was an increase of 166,000 cattle tested for interstate shipment, compared with the previous fiscal year. A limited amount of tuberculin testing was conducted in the public stockyards by the Bureau veterinarians. Testing done in connection with interstate shipment of cattle is included in the total testing reported in table 21.

## BANG'S DISEASE

During the latter part of the fiscal year ended June 30, 1934, the owners of cattle and others interested in that industry believed that some action should be taken toward eliminating Bang's disease. They asserted that the removal of cattle reacting to the test for this disease would be a desirable measure, as it would remove some of the surplus cattle and also tend to reduce losses from this trouble. Soon after that time, emergency funds were made available through the Agricultural Adjustment Act and allotted to the Bureau.

The testing of cattle for Bang's disease by the employees of the Bureau began in July 1934, and arrangements were made to make Federal payment for reactors; the maximum payment for grade animals was \$20 and for purebred registered cattle \$50. The owner received a salvage in addition to the Federal payment. The work was voluntary as far as the cattle owners were concerned, but they were required to sign an agreement calling for certain action on their part that was considered necessary in handling Bang's disease in cattle. At first, the testing was limited to two herd tests but was extended to four tests after additional funds were made available.

The total sum allotted for this project, including operating expenses and Federal payment for reactors, was \$25,500,000, and it was made available until December 31, 1935. During the fiscal year ended June 30, 1935, agglutination tests for Bang's disease were applied to 3,319,065 cattle, a few being retests. These animals were contained in 212,514 herds, and of the number tested, 381,189 cattle, or about 11 percent, were found to be reactors. The tests, which were conducted in four States, indicated that about 40 percent of the herds that were tested were infected. Subsequent retesting has indicated that good progress is being made in eliminating Bang's disease by following this program.

Many of the States were in a position to proceed rapidly with this project in cooperation with the Bureau, because of plans already in effect. The legislature of Maine provided for a State payment for Bang's disease reactors, limiting the payment to \$20 for grade cattle and \$50 for registered purebred

cattle. West Virginia also has a provision to pay a limited amount for reactors in Bang's disease work. In Oregon, the legislature provided that counties should arrange to carry on the Bang's disease work among dairy and breeding cattle. Steps have been taken in Virginia to carry on the testing on a county-wide basis in two counties.

The maximum Federal payment for grade cattle was increased from \$20 to \$25 on June 10, 1935, and the owners were required to sign new agreements, which contained more rigid requirements concerning the handling of herds under supervision.

The average appraisal of reacting cattle in the Bang's disease project for the fiscal year 1935 was \$56.86, the average salvage was \$19.87, and the average Federal payment, \$24.29. Eighteen percent of the reactors were registered purebreds.

#### MASTITIS

During the latter part of the calendar year 1934, a number of persons interested in the dairy industry in the Northeastern States requested that some action be taken to make Federal payment to owners of dairy cows when they were rejected on account of being infected with mastitis, after physical examination to conform to the various municipal ordinances. The sum of \$1,000,000 from an emergency allotment was set aside for this purpose, and the plan was put into operation early in January 1935. Some funds were allotted to all the States, but the largest allotments were made to the States located in what is known as the New York milkshed.

This plan called for the elimination of the marked physical cases of mastitis, and Federal payment was limited to \$20 for grade cattle and \$50 for purebreds. The owner received the salvage, and he was required to sign an agreement to attempt to control the disease in his herd and also to participate in the Bang's disease program.

During the fiscal year ended June 30, 1935, physical examinations were made for mastitis in 3,808 herds containing 94,919 cows. The result of this examination by trained veterinarians indicated that there were 11,683 marked physical cases, which were removed, and 2,263 suspicious cases; 80,973 cows were apparently free from any physical symptoms of the disease. The average Federal payment was \$29.87 and the average salvage was \$31.73. Of the rejected cows, 39 percent were registered purebreds.

#### DIVISION OF VIRUS-SERUM CONTROL

The Division of Virus-Serum Control, directed by D. I. Skidmore, chief, conducted the administrative and regulatory work authorized by the Virus-Serum-Toxin Act.

##### WORK AT LICENSED ESTABLISHMENTS

At the close of the year supervision was exercised over 82 licensed establishments as compared with 83 last year. These establishments were distributed among 60 cities and towns in 21 States. At the close of the year 41 establishments were engaged in producing only anti-hog-cholera serum and hog-cholera virus, 35 were producing other biologics only, and 6 were producing both classes of products.

Bureau inspectors examined 203,028 hogs and 715 calves intended for use in licensed establishments. Of these, 54 hogs were rejected at the time they were offered for admission, and 10,073 hogs were rejected because of conditions developing later which made them unsuitable for use. The total number of animal inspections was 1,352,360. Bureau inspectors supervised 1,951 potency and 1,688 purity tests of anti-hog-cholera serum and 1,626 purity tests of simultaneous virus.

##### OUTPUT OF BIOLOGICAL PRODUCTS

Table 23 shows the quantities of biologics produced by licensed establishments under the Bureau's supervision. Only clarified anti-hog-cholera serum was produced during the year.



TABLE 23.—*Biological products produced by licensed establishments, fiscal year 1935*

Product	Quantity	Product	Quantity
Anti-hog-cholera serum and hog cholera virus:	<i>Cubic centimeters</i>	Bacterins—Continued.	<i>Doses</i>
Serum.....	472,991,628	Keratitis bacterin (bovine).....	518,317
Virus (simultaneous).....	40,277,088	Mastitis bacterin (bovine).....	324,296
Virus (hyperimmunizing).....	84,123,351	Metritis bacterin (bovine).....	21,109
Virus (inoculating).....	396,458	Mixed bacterin (avian).....	6,702,890
Aggressins:	<i>Doses</i>	Mixed bacterin (bovine).....	352,116
Anthrax aggressin.....	66,890	Mixed bacterin (canine).....	457,015
Blackleg aggressin (natural).....	4,383,929	Mixed bacterin (equine).....	95,650
Blackleg aggressin (cultural).....	1,361,889	Mixed bacterin (feline).....	12,018
Hemorrhagic septicemia aggressin.....	1,762,781	Mixed bacterin (rabbit).....	6,415
Total.....	7,575,489	Mixed bacterin (ovine).....	378,431
Antisera and sera:		Mixed bacterin (porcine).....	670,709
Abortion serum (bovine).....	2,479	Navel-ill bacterin (equine).....	67,591
Anthrax serum.....	298,081	Pulmonary bacterin (bovine).....	475,443
Blackleg serum.....	2,966	Pulmonary bacterin (porcine).....	145,874
Bronchisepticus serum (canine).....	5,332	Rhinitis bacterin (porcine).....	2,190
Distemper serum (canine).....	509,476	Roup bacterin.....	219,805
Distemper, influenza, and pneumonia serum (equine).....	40,241	Scours bacterin (bovine).....	171,376
Encephalomyelitis serum (equine).....	18,951	Scours bacterin (porcine).....	229,673
Erysipelas serum (porcine).....	250,602	Streptococcus bacterin.....	8,792
Hemorrhagic septicemia serum.....	118,507	Total.....	22,211,289
Mastitis serum (bovine).....	3,530	Vaccines and viruses:	
Mixed infection serum (avian).....	9,950	Abortion vaccine (bovine).....	177,156
Mixed infection serum (canine).....	70,893	Anthrax vaccine.....	2,287,545
Mixed infection serum (porcine).....	9,459	Blackleg vaccine.....	1,189,980
Navel-ill serum (equine).....	13,511	Distemper vaccine (canine).....	88,893
Normal serum.....	9,165	Distemper virus (canine).....	59,464
Scours serum (bovine).....	40,484	Ecthyma vaccine (sheep).....	224,300
Scours serum (feline).....	21,067	Encephalomyelitis vaccine.....	4,782
Scours serum (porcine).....	11,230	Erysipelas vaccine (porcine) (for export only).....	364,480
Venom serum.....	126	Laryngotracheitis vaccine.....	2,428,400
Total.....	1,436,050	Pox vaccine (fowl).....	12,320,200
Botulinus antitoxin.....	<i>Units</i>	Rabies vaccine.....	871,953
Tetanus antitoxin.....	179,327,500	Staphylococcus toxoid.....	8,970
Total.....	338,452,500	Tetanus toxoid.....	6,484
Total.....	517,780,000	Total.....	20,032,607
Bacterins:	<i>Doses</i>	Diagnostic agents:	
Abortion bacterin (equine).....	1,332	Mallein (intradermic).....	31,083
Anthrax bacterin.....	73,945	Mallein (ophthalmic).....	61,825
Autogenous bacterin.....	114,943	Mallein (subcutaneous).....	824
Blackleg bacterin.....	5,154,339	Pullorin.....	132,350
Cholera-typhoid bacterin (avian).....	1,987,175	Tuberculin (intradermic).....	1,902,520
Colon bacterin.....	2,400	Tuberculin (ophthalmic).....	32,402
Distemper bacterin (feline).....	3,725	Tuberculin (subcutaneous).....	71,568
Distemper, influenza, and pneumonia bacterin (equine).....	551,909	Tuberculin (avian).....	214,695
Hemolytic bacterin.....	50,300	Total.....	2,447,267
Hemorrhagic septicemia bacterin.....	3,407,578	Grand total:	
		Doses.....	53,702,702
		Units.....	517,780,000

## PRODUCTS REJECTED

Table 24 shows the quantities of biological products destroyed under the Bureau's direction as unfit for use. Most of these were rejected and destroyed in the course of preparation, but some were recalled from the market for destruction.

TABLE 24.—*Biological products rejected and destroyed under Bureau supervision, fiscal year 1935*

Product	Quantity	Product	Quantity
	<i>Cubic centimeters</i>		<i>Cubic centimeters</i>
Anti-hog-cholera serum		Hemorrhagic septicemia aggrassin	120,000
From animals found diseased	1,443,514	Abortion bacterin (bovine)	137,673
Contaminated and otherwise unfit	916,750	Abortion bacterin (porcine)	49,560
Hyperimmunizing virus (hog cholera):		Tuberculin (intradermic)	18,589
From animals found diseased	2,351,483		
Contaminated and otherwise unfit	239,708	Total	7,179,070
Simultaneous virus (hog cholera):			
From animals found diseased	1,001,915		
Contaminated and otherwise unfit	899,878		

## IMPORTS AND EXPORTS OF BIOLOGICAL PRODUCTS

The importation of veterinary biological products from foreign countries continued to be handled by the Bureau in cooperation with the Treasury and Post Office Departments and the Food and Drug Administration of the Department of Agriculture. At the close of the year two permits to import such products were outstanding. Eighteen shipments of biologics were offered for admittance to this country. Seventeen of these, upon examination by Bureau inspectors, were found to be biologics which had been exported from the United States but were returned for various reasons. The remaining one shipment was admitted, as it was covered by a permit.

Bureau inspectors, on request, issued 518 certificates to accompany shipments of veterinary biological products to foreign countries. These certificates covered the following quantities of products: Anti-hog-cholera serum, 15,620,225 cc; hog-cholera virus, 711,036 cc; aggrassin, 413,326 doses; bacterins, 249,186 doses; diagnostic agents, 61,505 doses; sera and antisera, 24,913 doses; botulinus and tetanus antitoxins, 2,917,000 units; vaccines, 341,100 doses. The total quantity of anti-hog-cholera serum reported to the Bureau as having been exported aggregated 18,600,725 cc. Additional exports, of biological products, not covered by Bureau certificates and of unknown quantity likewise were made to certain foreign countries which do not require certificates for such products.

## ZOOLOGICAL DIVISION

The scientific investigations of animal parasites and the development of control measures along the lines of medicinal treatment of infested stock and prevention of infestation by sanitary procedures were continued under the direction of Maurice C. Hall, chief.

## PARASITES OF HORSES

Further studies on the vertical migration, in soil, of horse strongyle larvae showed that but few larvae out of thousands that were buried in coarse sand reached the surface of the soil in 47 days; very little more vertical migration of larvae occurred in sandy loam; considerably more migration occurred in sandy clay, since in 1 test about 3.5 percent of the larvae buried in this soil reached the surface in about 6½ weeks. The character of the soil is a factor in vertical migration, and the physical texture of plowed soil influences the migration of the larvae to the surface. On the whole, these investigations show that deep plowing by itself is of value in controlling strongyles of horses.

## PARASITES OF RUMINANTS

## NEMATODES

Stephanofilariasis, a new bovine skin disease reported last year, is now known to be present in at least 14 States, namely, Arizona, California, Colorado, Florida, Kansas, Louisiana, Maryland, Mississippi, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. Investigations are being carried out on the life history of the parasite causing the disease.



Studies are in progress on the effect of various nematodes on the nutrition of sheep. Copper sulphate sprays on pastures and the value of tall lespedeza pastures as controls for sheep parasites are being tested.

## TREMATODES

Field studies show that in various Western States infestations of cattle with liver flukes range from 12 to more than 50 percent. One county in Utah conducted a liver-fluke campaign with emergency relief funds. Field investigations indicate that lasting results depend primarily on the establishment of effective drainage, all other methods being secondary.

Infection experiments were continued with the large American liver fluke, *Fascioloides magna*, which is the cause of large losses in beef livers and serious injury to infested sheep. Larval flukes were developed in the snail *Pseudosuccinea columella*. Three calves were fed larval flukes, but only one had flukes when it was examined post mortem 272 days later; 24 mature flukes were found; no eggs were ever found in the feces. Both of the remaining calves showed evidence of having been infested, since the livers were extensively scarred and pigmented; however, no flukes were recovered. Four young sheep were fed larval flukes and all became infected. One sheep was given 200 larval flukes and died in 107 days; another given 114 larval flukes died in 127 days. Flukes were present in both animals but had not reached maturity. Of the remaining 2 sheep, 1 was given 50 larval flukes and eggs were recovered from the feces 6 months later; this animal was examined post mortem 3 months later and 2 flukes were recovered. The remaining sheep was given 200 larval flukes; eggs were recovered from the feces 5 months later, and when the sheep was examined post mortem 11 months later 1 fluke was found in the liver. One pig was given larval flukes and was examined post mortem 273 days later; no flukes were found, but the liver showed extensive scarring and pigmentation. Fifteen rabbits were fed from 19 to 300 larval flukes each, and 8 of the 15 animals died in from 15 to 133 days. Evidence of infection was found in all the rabbits, but apparently the flukes do not maintain themselves for more than 2 months or reach maturity in this host; consequently, the rabbit is probably not a factor of importance in the spread of this fluke. Apparently the life cycle cannot be maintained through cattle since eggs are not passed; it can be maintained in sheep, but the infestation may be fatal.

Experiments with lime, both slaked and unslaked, and with kerosene, added in varying amounts to water, were carried out to determine their effectiveness in destroying snails which serve as vectors for the common liver fluke of sheep and cattle. Both forms of lime were found satisfactory, the unslaked acting with greater rapidity than the slaked. In these experiments kerosene was of no value for the destruction of aquatic snails.

## PROTOZOA

In clinical anaplasmosis marked changes occur in the white-cell count. There is a leucocytosis, a relative monocytosis, and neutrophilia, with a shift to the left (Schilling's formula), also an aneosinophilia. A marked drop in the red-cell count occurs, and there are marked changes in red-cell volume and hemoglobin content, resulting in anaemia. No changes of cell volume could be detected in sheep infected with virulent bovine blood. The fragility of the red cells is greatly increased during clinical anaplasmosis. Fragility appears to be slightly greater in carriers of anaplasmosis and piroplasmosis than in susceptible cattle. Freezing washed virulent red cells for 18 hours in dry ice did not appreciably affect the virulence. Heating them to about 60° C. for 25 minutes greatly attenuated the virulence apparently, a heifer receiving such cells developing a nonclinical anaplasmosis that was diagnosed microscopically. From studies of samples taken post mortem from fatal cases and during the incubation and clinical periods from living cattle, it has been determined that the red cells of the bone marrow, spleen, liver, and lungs are infected at about the same time and to the same degree as the red cells of peripheral blood.

Experimental vaginal infections with *Trichomonas foetus* have been established in heifers and sheep. Vaginitis and leucorrhea have followed; in a virgin heifer infection has persisted for more than 3 months; abortion freed another heifer of the infection and she became resistant to subsequent inocula-

tion. In a ewe at necropsy the flagellates were found in the cervix and in both horns of the uterus. There were no macroscopic or microscopic lesions and no parasites were found in sections.

#### ARTHROPODS

After 6 years of experimental work on control and eradication of cattle grubs in Prowers County, Colo., the number of noncooperators in this area increased, and a considerable percentage of the cattle in the area could not be treated. The grubs from untreated cattle and trail herds prevented complete eradication. The movement of flies from infested sections into the area was probably a factor in reinfestation. During the drought large numbers of cattle from outside the area were moved in and many owners of transient cattle would not cooperate. The area was not systematically worked during the group season of 1934-35, but some check-up work showed that the cattle in the center of the area, which had an average of 4.9 grubs per animal last year, had an average of 6.4 grubs per animal this year. An experiment is now under way in Colorado to determine the effects of grub infestation on milk production of dairy cows.

Experimental work in treating animals for grubs with small medicated rods was continued in order to prevent infection which might be carried by the rods from developing in the grub sac. It was found that materials in the rods (glue, cocoa butter, and derris powder in the proportion of 1:1:2) inoculated with virulent spores of malignant edema or anthrax were sterilized by heating under pressure at 400° F. for 2 hours without affecting the killing power of the mixture on grubs in cattle. Of a large number of chemicals tested, only colloidal iodine in the rods prevented development of malignant edema spores; iodine did not kill anthrax spores, and other drugs tried were not effective against either kind of spore.

Experimental work on control of grub in the head of sheep was continued in Texas and New Mexico. Post-mortem findings on range sheep and on experimental lambs and other data indicate the following: A single deposit of larvae of the fly, *Oestrus ovis*, in the nostrils of lambs during the season of adult fly activity in New Mexico causes an infestation which may persist at least 10 months. Some of the larvae may mature and emerge in 25 days. A large number mature and emerge in 65 days. Many of the minute larvae of the first stage remain as such on the mucosa of the nasal passages for several months. A definite cessation of development of the larvae occurs, beginning in September and extending through December. More than 90 percent of the grubs found in the heads of sheep during these months were small larvae of the first stage, and 96 percent were in the nasal passages. Subsequent examinations revealed a steadily decreasing number of first-stage larvae and a corresponding increase in the number of second- and third-stage larvae in the frontal sinuses. Since the greater percentage of infestation during the autumn and winter months consists of small larvae in the nasal passages, numerous nasal sprays and washes containing carbon disulphide, nicotine, pyrethrum, light oils, and other medicaments were tried, but were not effective as used. Experiments were conducted with chemicals and mechanical devices to prevent the fly from depositing larvae on the mucous membranes of the nasal passages. Various sticky substances were applied around the nostrils of sheep, but no satisfactory formula was found. Various kinds of guards or traps made of sheet metal were attached to the nostrils of sheep but so far they have not been effective.

#### PARASITES OF SWINE

In order to develop effective control measures for nodular worms of swine, investigations were carried out with the following results: (1) The eggs of *Oesophagostomum dentatum* and *O. longicaudum* were resistant to a temperature of -8° to -9° C. for 26 hours. (2) When the eggs were buried in moist soil to a depth of 24 inches, they hatched and the larvae appeared on the surface of the soil 24 hours after the eggs had been buried. Manure from swine infested with nodular worms was buried at various depths, the topsoil being dry; the eggs hatched and the larvae remained underneath the surface of the soil for 20 days, following which they migrated to the surface when it became moist. (3) Larvae which were exposed to air-drying indoors and outdoors died after about 25 days. (4) The lateral migration of nodular worm larvae was found to be very limited, 9 inches being the maximum distance that they were observed to migrate. (5) The infective larvae lived approxi-



mately 5 months outdoors on sandy clay soil; during this time the soil was exposed to the sun. These observations show that nodular worm eggs and larvae have a marked resistance to environmental influences that are usually more or less harmful to eggs and larvae of related worm parasites. This explains the difficulty in controlling effectively nodular worm infestation in swine by sanitation methods known to be effective in controlling kidney worms, lungworms, and other species of swine roundworms.

Experiments showed that infections of pigs with lungworms run a more or less regular course. There is first a period of about 30 days, during which no eggs are eliminated with the feces of the pigs. This is followed by a period of active multiplication of the lungworms, involving the production of very large numbers of eggs for several months in some cases. Then there is a decline in egg production. Finally, many, perhaps all, of the worms in the lungs become surrounded by a cellular exudate, thus terminating the active infection. At this stage the pigs are still more or less susceptible to reinfection, but the worms which now reach the lungs develop rather slowly and the egg production of those reaching fertile maturity is decidedly less than that of worms in the first infection. Age appears to be a factor in resistance to lungworm infestation; although some lungworms develop in pigs about 5 or 6 months old and previously uninfested, the worms do not attain the maximum size and their egg output is rather low. Earthworms collected in an old hog lot at all seasons, over a period of about 18 months, were found to be infested with lungworm larvae. This shows that pigs can acquire an infestation with lungworms during any season, provided they have access to infested earthworms.

Tests of curing methods for sausages of various kinds and sizes, with reference to the destruction of trichinae by these methods, were carried out in various meat-packing establishments in Chicago, in response to a request from the meat industry. These tests showed that the existing limits on the diameter of sausages processed under Federal supervision can be modified to some extent if the time that larger sausages are held in cure, in the drying room, and in smoke is increased. Further investigations on the incidence of trichinae in garbage-fed and grain-fed hogs showed that the feeding of garbage to hogs apparently results in an increased incidence of trichinae in these animals. Out of 1,973 samples of pork from garbage-fed hogs, 95 contained live trichinae, the percentage of infestation being 4.8; out of 2,146 samples of pork from grain-fed hogs, only 33 contained live trichinae, the percentage of infestation being 1.5. In addition to the above tests, 3,254 official samples of meat food products containing pork-muscle tissue were examined for the presence of live trichinae. These examinations showed that there is no danger of acquiring trichinosis from the consumption of pork food products of kinds processed in accordance with the Federal regulations with a view to destroying the vitality of trichinae.

Field tests on the control of kidney worms and other parasites of swine under farm conditions were continued in the vicinity of Moultrie, Ga., in cooperation with vocational students in agriculture and others. Out of 214 pigs, raised under a special plan for controlling kidney worms, the kidneys of 201 pigs (94 percent) were free from parasites; only 46 livers were condemned as unfit for food, the remaining 168 livers (78.5 percent) being either free from worms or so lightly infested that the few lesions present could be removed readily by trimming. Almost equally good results were noted in the course of post-mortem examinations of 63 hogs raised in Florida and Alabama under sanitation, the precise method of management being somewhat different from that used in Georgia. In contrast to the results noted above, one lot of 22 pigs raised without regard to sanitation, near Berlin, Ga., was found to be infested to the extent of 100 percent, all of the livers and kidneys being discarded because of the presence of numerous parasites and lesions. The pigs raised under the special set-up for kidney worm control harbored comparatively few lungworms; this confirms earlier observations on the value of sanitation together with the use of temporary pastures, as an effective weapon for combating lungworm infestation in swine.

## PARASITES OF POULTRY

### NEMATODES

Natural infestations with one of the crop hairworms, *Capillaria contorta*, were the cause of death of turkeys in Virginia and of mountain quail brought from Oregon to Maryland. Experimental infestations were produced in six turkeys

and a bobwhite quail, observations being made on the life history and pathogenicity of this crop hairworm. The infectivity of the eggs was demonstrated as early as 46 days and as late as 11 months after culturing; complete development in the bird host, with hairworm eggs passing in the droppings, occurred in from 45 to 54 days. Attempts to infect chickens, guinea fowls, pigeons, and a crow were unsuccessful. A review of our knowledge of this and of 10 other species of *Capillaria* of the upper digestive tracts of birds was prepared for publication. Life-history experiments with another of the crop hairworms, *C. annulata*, are still in progress, repeatedly unsuccessful attempts to produce artificial infestations having been made. The poultry gullet worm, *Gongylonema ingluvicola*, was found for the first time in mountain quail, and the third-stage larvae of this nematode were developed for the first time in cockroaches. Eye worms from the ruffed grouse, prairie chicken, and sharp-tailed grouse of Michigan were identified as *Oxyuris petrowi*, formerly unknown from Galliformes or from this country; a review of known species of *Oxyuris* of birds was prepared for publication. A monographic taxonomic study was made of the Filarioidea and Dracunculioidea of birds; new species of Spiruroidea of birds also have been described. Investigations are under way to determine the effect of variations in dietary calcium on parasitic infestations in chickens.

#### CESTODES

A study was completed of the development and morphology of the tapeworm *Hymenolepis cantaniana* in its insect and poultry hosts. Developmental stages of the larvae were described from the dung beetle *Ataenius cognatus*; the dung beetles *Choridium histeroides*, from the vicinity of Washington, D. C., and *Ataenius stercorator*, from Puerto Rico, were found as additional hosts. Twelve chickens, one guinea fowl, and one bobwhite quail were experimentally infected with *H. cantaniana* by being fed larvae from *A. cognatus*; the cestode developed to the adult stage in a minimum time of 14 days. Work has been continued on the life history of *Raillietina echinobothrida*. A cestode, *Hymenolepis microps*, previously unknown in this country but of common occurrence in European game birds, has been found in ruffed grouse. Data have been obtained to show that grasshoppers serve as intermediate hosts for the turkey cestode *Metrolia sthes lucida*; turkeys and guinea fowls were infected by being fed larvae obtained from grasshoppers which had previously been given segments of *M. lucida*. In experiments with chickens infested with a single specimen of the tapeworm *Raillietina cesticillus*, it was found that the daily rhythm in the passage of segments was correlated with alternating periods of activity and rest and with the intake of food. Chicks infected at 10 days of age with the tapeworm *R. cesticillus* exhibited marked unthriftiness and gained in weight much less rapidly than did control chicks which were not infested.

#### PROTOZOA

In turkeys, chickens, and guinea fowls there has been found a flagellate, a species of *Pentatrichomonas*, associated with lesions of the ceca and the liver which were similar to those of blackhead. The organisms were cultured and studied morphologically, and experimental infestations produced; cecal infections resulted in 100 percent of 27 turkeys and 10 chickens, with accompanying liver lesions in 6, and cecal lesions in 2, of the turkeys, but without lesions in the chickens. The relationship of blackhead, due to *Histomonas meleagridis*, and the similar pathological changes associated with *Pentatrichomonas* is being investigated. In a natural outbreak of cecal coccidiosis due to *Eimeria tenella*, in approximately 100 chickens, under conditions of rigid sanitation, chickens which received vinegar, 1 part, in water, 79 parts, as their only drink showed less hemorrhage and gained weight more rapidly than chickens which received no vinegar.

#### MISCELLANEOUS PARASITES

##### NEMATODES

Detailed studies of representative animal-parasitic, plant-parasitic, and free-living nematodes have been made the basis of an extensive revision of the major groups of the Nematoda.

In a study of the temperature and moisture requirements for the development of the ova of the dog ascarids, *Toxocara canis* and *Toxascaris leonina*,



it was found that at a temperature of 30° C. in a saturated atmosphere ova of *T. canis* contained ensheathed or infective embryos 5 days after culturing. The ova of *T. leonina* developed more rapidly and contained infective embryos 3 days after culturing. At a temperature of 37° in an atmosphere saturated with moisture, ova of *T. leonina* became embryonated, whereas ova of *T. canis* under these conditions did not develop beyond the gastrula stage. Ova of neither species were able to develop at a temperature of 37° with a relative humidity of from 28 to 37 percent. Ova of *T. leonina* were able to survive on dog runs at Beltsville, Md., over the winter of 1933-34. The lowest temperature recorded was -27°; at the time the ground was covered with snow. Embryonated ova of *T. canis* survived exposure to a temperature of 0° for 4 days without any deleterious effect. Some of the ova were able to survive temperatures of -17.8° to -12.8° for 24 hours but were all killed by exposure to this temperature range for 48 hours. Unsegmented ova of *T. canis* and *T. leonina* developed normally after an exposure of 21 days to a temperature of approximately -17.8°. After an exposure to this temperature for 45 days, some ova underwent partial cleavage but did not become embryonated. An exposure of 60 days at this temperature was absolutely lethal to the ova.

In a study, in cooperation with the Smithsonian Institution, of the effect of ultraviolet light on the ova of *Toxocara canis* and *Toxascaris leonina*, it was found that a dosage of 137,000,000 ergs per square centimeter at a wave length of 3,022 angstrom units resulted in a marked lethal effect. Ova of *T. leonina* proved more susceptible than did ova of *T. canis*. Ultraviolet light at other wave lengths failed to exhibit the same lethal effect. The dosage employed was equivalent approximately to an exposure of 60 hours noonday, midsummer sun at Washington, D. C., or 12 days of average July sunlight.

Studies on the effect of vitamin A deficiency on the development of ascarids in dogs were completed. It was found that young dogs varying in age between 82 and 154 days, and maintained on a ration deficient in this vitamin for periods ranging from 15 to 106 days, were much more susceptible to infestations with *Toxocara canis* and *Toxascaris leonina* than were control dogs maintained on a normal diet, and exposed to the same degree of infestation. Young albino rats maintained on a diet totally deficient in vitamin A until they were showing definite symptoms of A avitaminosis exhibited a marked lowering of resistance to penetration and migration of the larvae of *T. canis*.

Experiments indicated that the life history of *Toxocara canis* is essentially the same as that reported for *Ascaris lumbricoides* and *A. suum*. There are four larval stages in the development of the parasite. The first molt takes place at the time the ova hatch or shortly thereafter. The second molt apparently takes place in the trachea or esophagus after the larvae leave the lungs. The third and fourth molts take place after the larvae regain the small intestine.

Investigations indicated that the life history of *Toxascaris leonina* is not in accord with the heretofore accepted view that the development is similar to that of *Ascaris lumbricoides*. Evidence indicated that the larvae, when released from the eggs, do not regularly migrate throughout the body organs of the host but develop to third-stage larvae in the wall of the small intestine, particularly in the duodenum.

Studies were conducted on the periodicity of the microfilariae of the dog heart worm, *Dirofilaria immitis*, by transfusing blood from an infested dog to a dog which had not been exposed to infestation. The results obtained indicated that the microfilariae will live for several months in the blood of dogs uninfected with adult worms, and that periodicity of the larva cannot be explained, in the case of this species, on the basis of cyclical parturition of adult female worms.

Application of a saturated solution of sodium chloride to the soil of dog runs at the rate of 0.107 gallon per square foot of soil was found to be destructive to hookworm larvae, and to prevent hookworm infestation in dogs maintained on such runs.

A reinvestigation of the preparasitic development of *Nippostrongylus muris* showed that the free-living larvae molt twice just as do other strongyles, contrary to the findings of a previous investigator. In a continuation of basic studies on the phenomena of resistance to parasitic infestation, it was determined that the transfer of adults and preadults of *N. muris* by mouth to rats not previously infested with these parasites produced a resistance to a later experimental infection through the skin. This shows that the migration of the larvae of this species through the lungs is not essential to the development of resistance

by the host. In the case of a related nematode, *Longistriata musculi*, parasitic in the mouse, a single massive percutaneous infection resulted in a relatively slight egg output which lasted but a few days; a single massive infection through the mouth resulted in a relatively large output of eggs, the production of eggs persisting for several weeks and still being rather high at the time of the death of the host animals. It appears that in this case the passage of the larvae through the hosts' tissues stimulated the defense mechanism, thus terminating egg production rather early in the course of the parasitic infestation.

#### TREMATODES

A monograph of the North American monogenetic trematodes was completed; a number of new trematodes were described. The life histories of several trematodes were ascertained, one of the flukes, *Echinostoma coalitum*, a muskrat parasite, being developed to complete maturity in the rabbit.

#### PROTOZOA

A paper reporting canine babesiasis in the United States was published during the year, and material was obtained for a study of the disease.

#### ARTHROPODS

A new species of tick belonging to the genus *Ornithodoros* was described. This tick is closely related to other species of the genus known to be vectors of relapsing fever of man, and it is possible that this species also may be a vector of this or a related disease.

#### TREATMENT FOR INTERNAL AND EXTERNAL PARASITES

Studies concerning the correlation between anthelmintic efficacy and chemical structure were continued with compounds of the cyclohexane series. In these experiments chlorcyclohexane proved to be 97 percent effective for the removal of ascarids and 75.5 percent effective for the removal of hookworms from the dog. Bromcyclohexane was less effective for the removal of ascarids but slightly more effective for the removal of hookworms than was chlorcyclohexane. The drug removed 64.4 percent of the ascarids and 78.8 percent of the hookworms from the experimental animals.

The purified active principle of the anthelmintic, leche de higueron, the sap of the Central American and South American fig tree, *Ficus laurifolia*, tested in a single experiment, failed to exhibit any anthelmintic efficacy for the removal of ascarids, hookworms, whipworms, or tapeworms from a dog. Apparently the animal in question succumbed to the effects of the treatment.

During the last year, the drug foudadin, which was previously found to be of value in the treatment of infestations with the dog heart worm, *Dirofilaria immitis*, has had widespread application in the field, apparently with satisfactory results in most cases. In efforts to discover additional effective treatments for this disease, emetin hydrochloride, ichthargan, antimony thioglycolamide, and antimony sodium thioglycollate were tested, but none of these were effective.

In an effort to develop a satisfactory treatment for nodular worms, *Oesophagostomum* spp., in swine, nicotine was incorporated in various inert substances to prevent rapid absorption in the stomach and small intestine and to permit the drug to be carried in sufficient concentration to the large intestine. Although some of the nicotine preparations employed were partially effective for the expulsion of large intestinal roundworms, none was effective for the removal of nodular worms.

Attempts were made to simplify the carbon disulphide treatment for stomach worms of swine by administering potassium xanthate, a compound which liberates carbon disulphide in an acid medium. This drug proved to be ineffective for the destruction of stomach worms and decidedly toxic to the treated animals.

In experiments to find drugs effective against nodular worms in sheep, p-octyl phenol, p-nonyl phenol, n-hexyl-m-cresol, butyl bromide, and iodine ben-tonite were tested, but none of these compounds proved to be effective for the removal of nodular worms or other intestinal parasites from sheep. In tests with nicotine combined physically with certain inert substances, one of

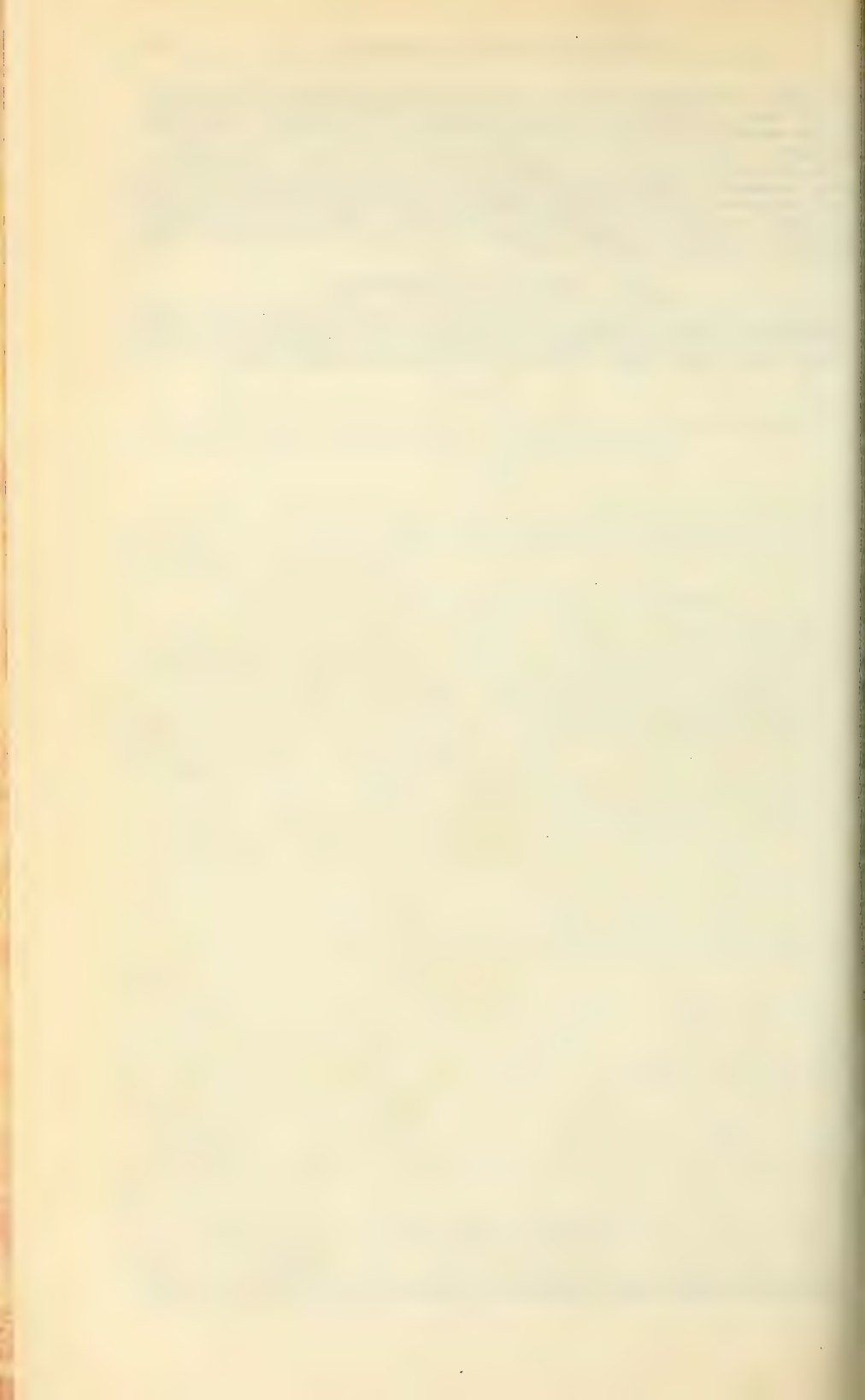


the combinations proved to be very effective for the removal of hookworms, nodular worms, and *Chabertia ovina* from sheep. Difficulties were encountered in the administration of this combination because of the bulk of the dose employed.

One-percent derris powder containing 5 percent of rotenone, in kaolin in a single application, was found to be effective for the destruction of the hog louse, *Hæmatopinus suis*, the biting louse of cattle, *Trichodectes scalaris*, and the biting louse of horses, *T. pilosus*. When used as 0.5 percent of derris in kaolin, the powder was effective against hog lice, but two applications were required for the destruction of all lice.

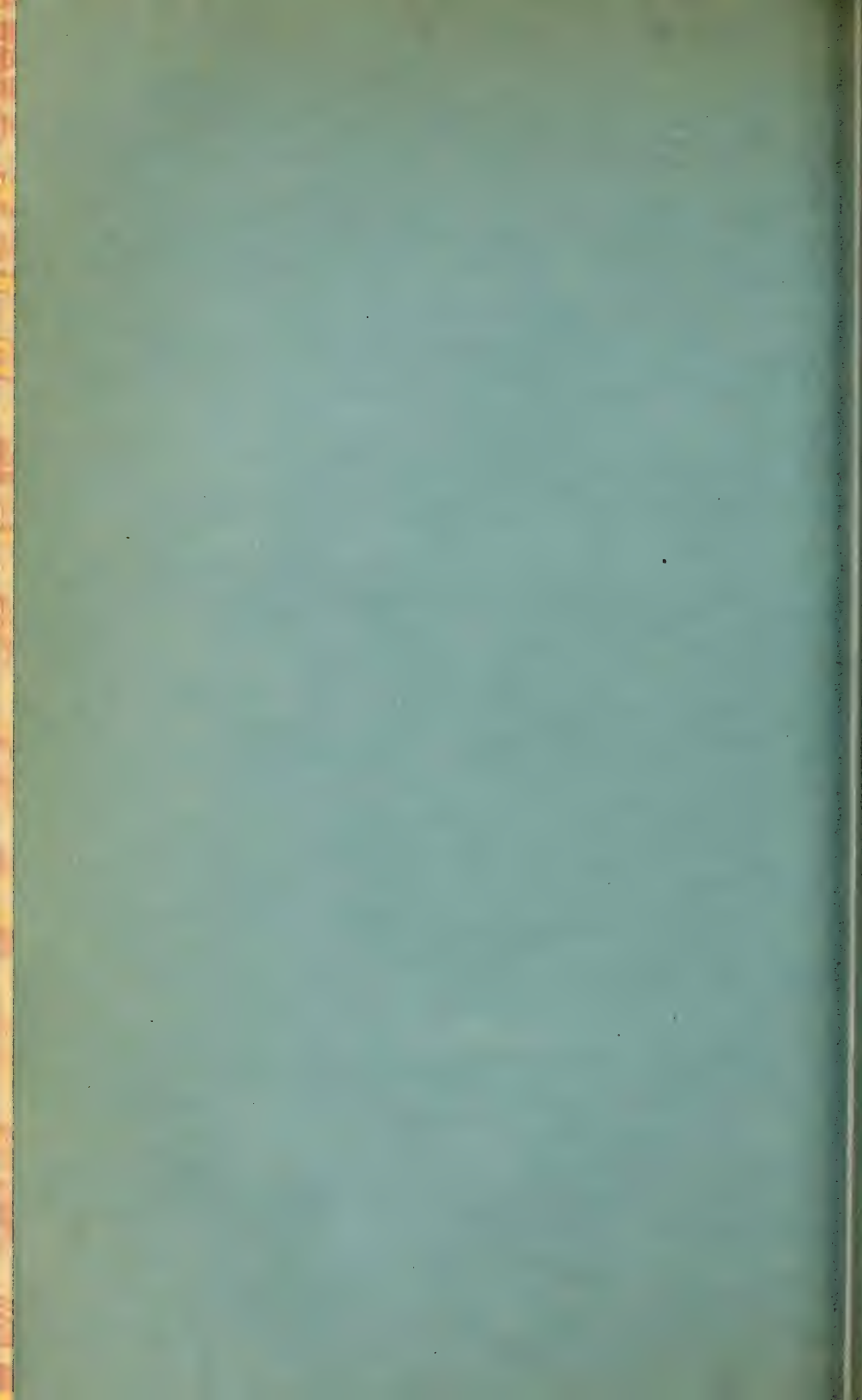
#### INDEX CATALOG AND COLLECTIONS

The index catalog of medical and veterinary zoology was maintained and work was continued in the preparation for publication of part 2 of the author catalog. There were 1,028 accessions to the helminthological collection.











# REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,

BUREAU OF BIOLOGICAL SURVEY,  
*Washington, D. C., August 30, 1935.*

HON. HENRY A. WALLACE,

*Secretary of Agriculture.*

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1935.

Sincerely yours,

J. N. DARLING, *Chief.*

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## INTRODUCTION

### THE YEAR'S CHIEF PROGRAM

It cannot be said that any valuable form of American wildlife is in a satisfactory condition at the present time. All have suffered from mankind's indifference or greed, but none is in a more precarious situation than our migratory waterfowl. For this reason practically all lines of work of the Bureau of Biological Survey were to some extent subordinated during the year to the all-important program of waterfowl restoration. Research was extended in order to strengthen the scientific basis of the undertaking; existing wildlife refuges were rehabilitated; regulatory and law-enforcement activities were greatly increased and had as their chief objective the perpetuation of necessary breeding stocks of the various species of wild fowl; and an extensive new migratory-waterfowl restoration program was launched.

The important place of wildlife in land-planning uses was stressed, and its needs have become more generally understood by those in charge throughout the Government. Conditions that favor wildlife and promote the perpetuity of wilderness areas are now widely recognized as being identical with those that alleviate the effects of drought, provide for flood control, and prevent soil erosion. The Bureau has effectually demonstrated that plantings to nullify harmful wind action, to conserve moisture, and to reduce the run-off from rainfall and melting snow are also wildlife-conservation measures. A timely article bearing on another aspect of wildlife restoration and widely distributed was published in the 1935 Yearbook of Agriculture (pp. 220-221) under the title "Game as a Farm Crop Emphasized by Agricultural Adjustment."

The waterfowl restoration project also dovetailed with the emergency relief programs of the Government. Great numbers of individuals who would otherwise have been in dire need were employed on work for refuge acquisition and improvement, and, through control of injurious species of wildlife, on work not only for improved production in agriculture and stock raising but for the welfare of valuable game and other species of the wild native fauna.

The public is beginning at last to understand that in many instances the former domain of wildlife has been needlessly taken from it, frequently with no permanent benefit to man. It is now generally known that it is possible to have our wildlife, our forest and wilderness areas, and our natural water reservoirs and still attain vastly higher levels of crop production than in the past. There is land enough to meet generously every national need, every requirement of agriculture, industry, and recreation, and at the same time to restore great acreages of submarginal lands to their best uses—waterfowl,

fur, and fish production. And it has been demonstrated that the restoration of marshlands to these primitive uses has advantages not only to the wildlife resource but also to man. Furthermore, land better adapted to wildlife than to farming may actually, if indirectly, through its attractiveness to sportsmen, hunters, trappers, and nature students, support more people in a correct than in an incorrect use. It is on these principles that the migratory-waterfowl restoration program has been based.

Wild-fowl conservation by reducing the annual kill by hunters has also been stressed as part of the restoration program. During the 1934-35 season the shooting of waterfowl was restricted to 30 days between October 1 and January 13, and among other restrictions was the prohibition of baiting waterfowl to blinds and shooting stands, except under permit from the Secretary of Agriculture. Studies of the needs of waterfowl were continued, with the result that on July 30, 1935, after the close of the fiscal year covered by this report, the most rigid regulations in the history of American wildfowling were promulgated for the fall and winter of 1935-36. The country was divided into a northern and a southern zone, with only a 1-month continuous season in each, with shooting hours from 7 a. m. to 4 p. m.; daily bag limits were further reduced and the possession limit made the same as the daily bag; sinkboxes and open-water shooting, as well as bait and live decoys, were prohibited for waterfowl hunting; and automatic repeating guns carrying more than three shells were ruled out by a regulation approved on February 2. These hunting methods were discussed in an article in the 1935 Yearbook of Agriculture (pp. 328-330) under the title "Waterfowl Problems Clarified by Study of Gunning Practices." The year's chief program has thus been threefold—waterfowl restoration, refuge establishment, and law enforcement, with particular attention to the restoration program.

The continuing migratory-waterfowl program involves acquisition by the Bureau of a million acres in each of the fiscal years 1935-36 and 1936-37. This will bring the total number of Survey refuges to more than 200, involving 4,500,000 acres of wildlife-refuge land, more than 3,600,000 acres primarily of value to migratory waterfowl. The complete rehabilitation of our country for the needs of migratory waterfowl, without conflicting with other agencies and without appreciable industrial or economic loss, requires the restoration of 7,500,000 acres, now held in uneconomic or insufficiently productive industrial or agricultural use.

Preliminary surveys have revealed that there are at least 20 types of sub-marginal land available for refuge purposes. It was early determined, however, that the waterfowl situation would not be helped merely by purchasing an area that is still naturally good and productive, but rather by restoring devastated areas formerly known to have a good waterfowl history and an important annual waterfowl production.

This is the program that the Biological Survey hopes to achieve by 1940. With the present trained force available, and with a continuance of the sympathetic interest and support of the various emergency programs, of State conservation departments and conservation societies, and of the thousands of sportsmen who annually depend upon migratory waterfowl for a few days' enjoyable sport afield, this is not an unattainable goal, but one of imminent practical approach and affording hope for reasonably speedy consummation.

#### REGULAR AND SPECIAL FUNDS AVAILABLE

Funds for financing the Bureau's operations have increased from the first appropriation 50 years ago of \$5,000 to an approximate average for each of the past few years of a million and a half dollars in regular funds. For the year covered by this report, the regular appropriation had been reduced to \$1,054,084, but the Bureau's program was financed by allotments from emergency funds aggregating \$8,500,000, and by proceeds of about \$600,000 from the sale of migratory-bird hunting stamps, and during the last month of the year a special appropriation for wildlife-refuge establishment of \$6,000,000 was made, to continue available until expended. In addition, for the past 20 years the Bureau has administered cooperative funds for mammal-pest control that have frequently far exceeded the appropriations made by Congress for the purpose.

The money obtained by the Bureau during the year from various emergency appropriations gave great impetus to the long-needed refuge-acquisition and development program. It provided the most noteworthy contribution the Fed-



eral Government has ever made to wildlife. An emergency-conservation fund of \$1,000,000 for acquisition of refuge lands was practically entirely obligated, and approximately \$2,100,000 of a \$2,500,000 fund for rehabilitation of new and old refuge areas was either expended or obligated. The authorization for the use of these funds expired on March 31, considerably less than a year after the money was actually made available, and the time limit precluded the wise expenditure of the \$400,000 balance, which was thus allowed to revert to the Treasury. Nearly all of a fund of \$5,000,000 earmarked by the Federal Emergency Relief Administration for purchase of migratory-waterfowl refuge areas was obligated, resulting in the obtaining of a group of the most outstanding waterfowl-refuge areas in the country.

Valuable and highly appreciated cooperation and sympathetic consideration were received from the Federal Emergency Relief Administration, the Public Works Administration, the Emergency Conservation Work organization, and the Resettlement Administration, and the Bureau in turn planned its activities to assist in the Government's recovery program.

#### SEMICENTENNIAL RÉSUMÉ

With the end of the year 1935 marking the semicentennial of the establishment of the organization now known as the Bureau of Biological Survey, it is appropriate to present in the annual report for this year a brief glimpse of the Bureau's history, the details of which are to be found in the preceding 49 annual reports. Instituted on July 1, 1885, as a Branch of Economic Ornithology in the then Division of Entomology, and made a full Division of Economic Ornithology and Mammalogy 1 year later, this organization for the first 15 years was given over almost wholly to the research covered by its designation. Continuing to the present, this function has expanded with the delegation to the Bureau of enlarged duties—in 1900 game protection, 3 years later the beginning of administration of bird refuges, in 1915 cooperative control of predatory animals and injurious rodents, and 3 years later execution of the Federal Government's responsibilities in the protection of migratory birds under international treaty. During the past 2 years increased attention has been given to the needs of migratory game birds, this year by the institution of the extensive program of restoration of migratory waterfowl.

The present designation of the Bureau (Division of Biological Survey in 1895, with bureau status 30 years ago) recognizes a basic line of its scientific work—making biological surveys of States and of other large areas within natural boundaries. The results of its research, service, and regulatory activities have been published in numerous bulletins and circulars; in its own technical series, the North American Fauna; and in the annual reports of its Chiefs, as follows: 1885 to 1909, by C. Hart Merriam (except 1898 to 1901, by the Acting Chief, T. S. Palmer, and in 1906 by the Acting Chief, Henry W. Henshaw); 1910 to 1916, by Henry W. Henshaw; 1917 to 1926, by Edward W. Nelson; 1927 to 1933, by Paul G. Redington; and 1934 to 1935 by the present Chief.

The net results of the work over the past half century have been reflected in an increasingly conservation-minded public, as the Bureau has developed and published the facts regarding the economic, recreational, and esthetic values and the requirements of wildlife; in the building up of a public sentiment that has made possible the necessary but heretofore unheard-of restrictions on the hunting of wild fowl and the trapping of other game and fur animals; in the service to agriculture, horticulture, stock raising, and forestry worth millions of dollars annually, through demonstrations and cooperation in the suppression on a scientific basis of wild-animal hindrances to production; and in the reservation, acquisition, and administration of a now rapidly increasing number of bird refuges and big-game preserves established at strategic points in the former domain of the native fauna for the perpetuation of adequate representatives of the various species.

Reorganization of the Bureau during the past year and rehabilitation of its work have added impetus to its program of wildlife conservation and have measurably increased public support and cooperation in furthering its definitely stated objectives.

There was no official observance of the Bureau's semicentennial, but a dinner to celebrate the event was arranged by a committee of the personnel in February, attended by the Secretary and other officials of the Department, representatives of Congressional wildlife-conservation committees, the first Chief of the Bureau, and former and present members of the force. The Division of Public Relations,

in two numbers of the Bureau's mimeographed house organ, also issued a brief history of the founding of the Bureau, written for the purpose by its first chief, Dr. Merriam, and a résumé of the research operations of the personnel during the first 20 years. It is planned to combine these in a mimeographed leaflet with any similar articles that may be written in further celebration of the semi-centennial of the Government's "wildlife service", to place the facts on record for the information of cooperators and others interested.

#### THE PRESENT ORGANIZATION

Since the reorganization of the Bureau on July 1, 1934, and the consolidation of service and regulatory units in the Division of Game Management and of scientific sections in the Division of Wildlife Research, mention of which was made in last year's report, technical research work on mammals has been segregated in a new section of mammalogy; specialized sections have been erected in the Divisions of Land Acquisition and Migratory Waterfowl, and administration of bird refuges has been placed under the Division of Migratory Waterfowl, the big-game preserves being continued under the Division of Game Management. The present organization of the Bureau, with officials in charge, is as follows:

Chief	J. N. Darling
Associate Chief	W. C. Henderson
Technical adviser	W. L. McAtee
Division of Administration	W. R. Dillon
Assistant	T. E. Jacoby
Section of Personnel and Pay Rolls	E. J. Thompson
Section of Accounting	S. C. Moore
Section of Purchases and Property	J. L. Talbert
Section of Mails and Files	W. D. Hobbs
Division of Public Relations	H. P. Sheldon
Assistant, in charge of Editorial and Information Section	W. H. Cheesman
Section of Visual Information and Publication Distribution	Lisle Morrison
Division of Wildlife Research	W. B. Bell
Assistant	I. N. Gabrielson
Section of Mammalogy	H. H. T. Jackson
Section of Distribution and Migration of Birds	F. C. Lincoln
Section of Food Habits	Clarence Cottam
Section of Fur Resources	Frank G. Ashbrook
Section of Disease Control	J. E. Shillinger
Division of Land Acquisition	Rudolph Dieffenbach
Section of Appraisals and Negotiations	R. M. Rutherford
Section of Surveys and Maps	A. A. Riemer
Division of Migratory Waterfowl	J. C. Salyer, II
Assistant, in charge of Section of Maintenance and Patrol	A. C. Elmer
Section of Reconnaissance and Habitat Improvement	W. F. Kubichek
Section of Restoration and Development	Amos B. Emery
Division of Game Management	Stanley P. Young
Assistant, in charge of Section of Big Game Refuges and Game Agents	W. E. Crouch
Section of Law Enforcement	F. P. Callaghan
Section of Importations and Permits	R. W. Williams
Section of Predator and Rodent Control	A. M. Day

#### RETIREMENTS OF VETERAN WORKERS

Two veteran scientists of the Bureau were retired during the year—Edward A. Preble, on June 30, after 43 years' service, and Stanley E. Piper, on May 31, after 31 years. Mr. Piper, whose work had been concerned chiefly with the relation of native and other species to agriculture in the West, was the author of several publications on field-mouse control. Mr. Preble's work covered all phases of natural-history research, including field surveys in many States and Canada, and on the Pribilof Islands, Alaska. He was the author of a number of technical and other bulletins, including several numbers of the North American Fauna, his outstanding work (no. 27 of that series) reporting in 1908 on A Biological Investigation of the Athabaska-Mackenzie Region.

#### OUTSTANDING EVENTS OF THE YEAR

The events that marked the fiftieth year's work of the Biological Survey may be briefly summarized as follows:

*Reorganization.*—Beginnings of the Bureau's operations under the reorganization of divisions and sections effective July 1, 1934 (see organization list above).



## RESEARCH ACTIVITIES

*Game-management research.*—Completion of plans for a program of wildlife research, demonstration, and education, through cooperation with selected land-grant colleges and State game commissions in representative parts of the United States; and extension of cooperative studies on national forests.

*New research station.*—Transfer to the Biological Survey of administration of the Wichita National Forest and Game Preserve (Okla.), for use as a wildlife refuge and research station, for the maintenance and study of buffalo, elk, deer, Texas longhorns, game birds, and other wildlife.

*Waterfowl-habitat studies.*—Continuation of studies of waterfowl conditions in the United States, Canada, and Mexico, publication of data on the status and needs of waterfowl, and recommendations for controlling introduced aquatic-plant pests and modifying mosquito-control operations where detrimental to wild-fowl food plants and habitat.

*Fur production.*—Importance of the fur resource emphasized in land-management policies, and research on suitable species broadened on waterfowl refuges that afford good fur-animal habitat.

## WATERFOWL RESTORATION

*Refuge land acquisition.*—Completion of examination and appraisal of approximately 1,000,000 acres of proposed refuge lands, and consummation of negotiations for the acquisition of 925,570 acres, at an average cost of \$8 an acre.

*Waterfowl program.*—Important areas restored for waterfowl use under the program instituted through the new Migratory Waterfowl Division.

*Special funds.*—Allotment of \$8,500,000 in emergency funds for use at the beginning of the year for refuge acquisition and development, and appropriation of \$6,000,000 in June for expansion of the program.

*Cooperation in land use.*—Quickening of interest in wildlife problems by all Government agencies having large-scale field operations.

*Refuge development.*—Successful completion of numerous projects for the development and improvement of waterfowl and other wildlife refuges under National Recovery Administration and other allotments, and allocation of 26 Civilian Conservation Corps camps for such work.

## LEGISLATION AND REGULATIONS

*New legislation.*—Approval on June 15, 1935, of an act amending for improved administration purposes several laws administered by the Bureau for wildlife conservation; appropriating funds for acquisition of lands for wildlife refuges, and authorizing further allotments from emergency relief funds for the purpose; enlarging the powers of the Secretary in refuge administration; and providing for State participation in receipts from such administration.

*Baiting.*—Control of principal abuses of waterfowl baiting under a system of permits issued by the Chief of the Biological Survey, and requiring reports thereon for the 1934-35 season.

*Law enforcement.*—Completion of the first year's work by "flying squadrons", under which it was possible effectively to patrol large waterfowl concentration areas; apprehension of 48 duck sellers along the Illinois River; and a vigorous drive in California against clubs and restaurants selling game.

*Waterfowl hunting seasons.*—Complete readjustment of the 1934-35 waterfowl seasons and reduction of hunting from 60 to 30 days, spread over the period October 1 to January 13.

*Collecting permits.*—Revocation of all outstanding scientific collecting permits for migratory birds and reissuance on the annual basis to insure against misuse.

## PREDATOR AND RODENT CONTROL

*Predators.*—Increases reported in abundance of predatory animals, although more were destroyed than ever before.

*Rodents.*—Reduction of the numbers of injurious rodents on 11,166,935 acres for the protection of farm crops, range grasses, silvicultural plantings, reclamation-project waterways, and surface soils threatened by erosion, through extension of cooperation with Federal bureaus and emergency organizations.

## RESEARCH ON THE STATUS AND DISTRIBUTION OF WILDLIFE

## WATERFOWL STUDIES

An extended and intensified investigation of waterfowl conditions during the summer of 1934 covered breeding grounds in the United States from Minnesota west to the Pacific coast, important parts of Canada, and wintering areas in Mexico. Canadian observations by four field parties were made on breeding grounds in British Columbia, Alberta, Saskatchewan, and Manitoba, and extended north to Lake Athabaska. The condition of the birds was found to be most unsatisfactory, and the facts developed demonstrated that the additional restrictions on hunting were fully justified. In practically all the drought region duck production was reduced almost to zero. The status of the birds in northern areas not affected by drought was discussed in an article in the 1935 Yearbook of Agriculture (pp. 326-328) under the suggestive title "Waterfowl Breeding Grounds of Far North Now Poorly Tenanted."

In Mexico investigations were conducted by two experienced representatives from December 1934 to the last of April 1935, from the Valley of Mexico south to Yucatan and the Guatemalan border. These men found that ducks have decreased greatly over all of these important wintering grounds. The fact, however, that there has not been a comparable increase in destructive factors in that country, clearly indicates that the losses are traceable to conditions in the United States and Canada.

The fall migration of 1934 was reported on by the regular personnel of the Bureau and by 498 volunteer observers, and during the week of January 21, 1935, a simultaneous waterfowl inventory was made by all available personnel throughout the country. Though some of the worst storms of the season prevented the results from reaching expectations, important information was obtained and the experience gained in setting up the organization will prove valuable in further studies. Plans are being made to expand aerial observations during the coming winter, in cooperation with the Navy Department, as sea-planes were found of great advantage on relatively calm days in checking at low altitudes the concentrations of diving ducks and others in large rafts on open water. The spring migration of 1935 was covered by 450 strategically located volunteer observers, and 5 field parties continued investigations of waterfowl in Canada during the 1935 nesting season.

## BANDING GAME AND OTHER BIRDS

Banding operations continued to yield valuable information and were carried forward actively, particularly with waterfowl. Birds to the number of 249,829 were reported as banded during the year. For the first time the total fell below that of a preceding year, but it was not surprising, as there has been evidence that, probably as a result of lowered reproduction caused by drought, the smaller seed- and insect-eating birds have been present in greatly reduced numbers at important banding stations. Furthermore, it had been necessary to restrict the issuance of new banding permits. The number of cooperators has remained nearly stationary, at about 2,000, new permits issued in exceptional cases just about balancing the losses.

The number of return records of banded birds, 16,913, was also somewhat less than that reported in 1934, but it is significant that the percentage of usable data has been much greater as the number of banded birds is now well over 2,000,000.

The total number of waterfowl banded, however, showed an increase—42,427 for 1935 as against 40,524 for 1934. The pintail again occupies first place, with 15,177. The numbers by species are shown for the 2 years in table 1. The figures presented, however, should not be construed as representing the relative numerical status of the different species, or as indicating an increase or decrease in abundance.

Among nongame birds banded, the list is headed by the common tern, with 22,315, followed by the junco, with 15,486. The latter species is one of the most abundant North American birds, occurring everywhere and often in flocks of large size. Leading in numbers among the groups rather difficult to band are more than 2,000 herons of 10 species; more than 1,800 hawks, owls, and vultures of 30 species; and more than 2,000 shore birds of 24 species. Of the 378 species represented, 10 are new to the list of banded birds.

The significance of birdbanding was depicted in a motion-picture film released during the year, entitled "The How and Why of Birdbanding."



TABLE 1.—*Waterfowl banded in the fiscal years 1934 and 1935*

Species	1934	1935	Species	1934	1935
	Number	Number		Number	Number
American merganser.....	1		Greater scaup.....	163	156
Red-breasted merganser.....		8	Lesser scaup.....	2,045	1,299
Hooded merganser.....	2	5	Ring-necked duck.....	866	1,073
Mallard.....	9,424	14,937	Goldeneye.....	14	3
Black duck.....	7,618	4,037	Bufflehead.....	6	84
Gadwall.....	245	85	American elder.....		22
Baldpate.....	1,051	689	White-winged scoter.....		2
Green-winged teal.....	2,521	2,307	Ruddy duck.....	7	15
Blue-winged teal.....	146	973	Snow goose.....	19	73
Cinnamon teal.....	304	42	Blue goose.....	176	53
Shoveler.....	110	75	White-fronted goose.....		1
Pintail.....	14,290	15,177	Canada goose.....	193	302
Wood duck.....	293	435	Whistling swan.....	2	1
Redhead.....	635	350			
Canvasback.....	393	213	Total.....	40,524	42,427

## RECORDS AND MAPS OF BIRD DISTRIBUTION

Accumulated migration-record cards of the past 2 years, to the number of more than 95,000, have been distributed by species, and the further break-down by States and other major political divisions is progressing as rapidly as use of the cards in mapping will permit. Maps portraying the breeding and wintering ranges of migratory waterfowl, shore birds, and other important groups are being maintained as nearly up to date as possible. Migration reports to the number of 200 were reported during the year from volunteer cooperators, continuing in many cases regular reports on the same areas over long terms of years.

## STATUS OF UPLAND GAME BIRDS

Data are being collected from the game departments relative to the present status of upland game birds in the several States. An excellent spirit of State cooperation has been shown, and when all reports have been received it will be possible to present the first Nation-wide study of its kind.

## RESEARCH ON BIG-GAME MAMMALS

## ELK HERDS

In cooperation with the Forest Service and the State Game Commission of Wyoming, a count of elk in the Jackson Hole country revealed 22,035 animals. At the request of the Forest Service, further studies were made of the elk and of grazing conditions in the Sun River section and part of the Flathead drainage in Montana, of winter ranges north of Yellowstone National Park, and on adjacent parts of the Absaroka National Forest, to assemble data as a basis for elk-management practices. The Absaroka range used by elk and by other big game was found so severely overgrazed that temporary reduction of the herd and the development of other grazing areas were recommended. A considerable reduction was effected during the fall and winter by liberalized hunting regulations.

To obtain specific information on elk and to correlate the findings for the entire western United States, with a view to rounding out information required for a comprehensive report on the elk of North America, studies of the species were made also in Idaho, Nevada, California, Arizona, and Utah. Of special interest was the examination of the habitat of the coast elk in northwestern California, the Tule elk herd near Bakersfield, Calif., and the ancient ranges of the now extinct Merriam elk in Arizona, where Rocky Mountain elk have recently been introduced. Particular attention was given to the relation of elk and livestock grazing. During February and March investigations were made of the Roosevelt elk on various ranges of the Olympic Mountains and the condition of the food supply, especially in winter, which is the key to the situation. As a result of this study necrotic stomatitis was determined to be the principal cause of winter losses in the Olympic section, and occurrence of this disease was definitely correlated with overpopulation and consequent overbrowsing. The findings were reported to the Forest Service, to the National Park Service, and to game authorities of the State of Washington.

"Why Save the Elk?" is the title of a motion picture completed and released during the year for visual information on this important big-game project.

## WICHITA WILDLIFE

A study of the game, fur bearers, and other wildlife was made on the Wichita Mountains, in Oklahoma, where the Biological Survey will maintain a wildlife research station (p. 38). Observations were made of the numbers of buffalo, elk, and deer, as well as of Texas longhorns, wild turkeys, lesser prairie chickens, grouse, and quail. The need was noted of increasing food and cover plants and making improvements through construction of dams to provide small lakes, and through food plantings, of trees, shrubs, or grasses, as a means of increasing the wildlife carrying capacity of the area. Further research and experiments will be carried out to obtain the basic information required for management practices on this area, and on other parts of the Great Plains region to which the results may be applicable.

## MOUNTAIN SHEEP

The serious problems confronting the mountain-sheep population of the western United States led to more extended studies of the various herds, to gather data on their numbers, food supply, and diseases, and particularly the need for setting aside suitable refuges on national forests and the public domain, where these valuable game animals may be more adequately protected and provided with food, cover, and range.

## MINNESOTA CARIBOU

Observations made of the caribou in northern Minnesota indicated that under the efficient program of protection now provided by the State this herd is continuing in a thrifty condition and may increase in numbers.

## FOREST WILDLIFE RESEARCH

Wildlife conditions were studied on the Superior National Forest in Minnesota during the fall and again during the spring, three experienced field naturalists being engaged on each occasion. This investigation was designed to provide information regarding the abundance and distribution of the forest wildlife, particularly the valuable upland game, waterfowl, and fur bearers, and the predatory animals, as a basis for a wildlife-management plan for the forest.

Four naturalists were employed during the year in a study of the relationships of wildlife to forestry, grazing, and other land use in cooperation with certain of the forest experiment stations. Special attention has been given to the relationship of rodents and birds to forest reproduction, particularly with reference to damage to seeds and to seedlings and other plants during periods of heavy snow. Facts regarding cyclic abundance and scarcity of valuable and harmful species were assembled, snowshoe hares were marked for record purposes, and trapping was intensively carried on. This work was closely correlated with disease investigations in progress.

In New England, studies of wildlife management in controlled forest areas have been continued. In this work Civilian Conservation Corps labor has been utilized in clearing tracts, cleaning out underbrush, and making plantings on the Pillsbury State Forest in New Hampshire. The aim has been to coordinate silvicultural methods with game management in order to effect the maximum production on forested areas.

At the request of the Forest Service, biologists again made inspections and recommendations on the work being done by the Civilian Conservation Corps camps on national forests in the Eastern and Southeastern States, and arrangements were made for employing wildlife technicians to recommend procedure for safeguarding and improving the welfare of the forest wildlife. The importance of the forest fauna was described in the 1935 Yearbook of Agriculture (pp. 221-223), in an article entitled "Game Management and Forest Protection are Related Tasks."

## COOPERATIVE RESEARCH IN WILDLIFE MANAGEMENT

Plans were completed at the end of the year for initiating nine combined wildlife research, demonstration, and educational units in various representative regions, in cooperation with land-grant colleges and State game commissions. These projects will be for the purpose of conducting fundamental investiga-



tions, applying the results to local wildlife-management conditions, and carrying them to landowners, both public and private, by demonstration and extension methods. The Bureau will thus have a direct method for getting the results of its wildlife research into the hands of educators, students of wildlife management, farmers, and others concerned with land-use programs, who need and will apply the findings in the improvement of wildlife conditions.

### WILDLIFE INVESTIGATIONS IN ALASKA

#### MUSK OX HERD

The musk ox herd has continued to thrive and multiply. Last year, for the first time since its introduction into Alaska in 1930, 7 calves were born, 1 being stillborn and 1 killed by another animal, and this year calving began 10 days earlier than last year, namely, on April 19, and the total calf crop was 12, but 2 were stillborn. The 5 yearlings from last year's crop have made a growth within their age class superior to that of the animals originally introduced. Each adult cow gave birth to a calf this year, but in one case of stillbirth the cow also died. At the close of the year the herd consisted of 12 adult bulls, 11 adult cows, 4 male and 1 female yearlings, and 10 calves, a total of 38. This increase of 4 over the original number of 34 introduced 5 years ago means that the herd has recouped its losses, has been carried through the period of growth to maturity, and is now reproducing satisfactorily.

It has been determined that the musk ox does not breed until 4 years of age and calves at 5 years. A definite observation of an individual breeding and calving demonstrated that the gestation period is 8 months, rather than 9 months, as previously thought.

Added knowledge of handling, the clearing of underbrush and down timber from the pasture, and the building of fences to control the movements of the herd eliminated losses from predators. With increasing age, however, the adults are proving less tractable to handling by herders on foot, and it is necessary to devise management practices for reducing the risk of injury to both animals and herders.

At the close of the year arrangements had been made in cooperation with the Alaska Game Commission to ship 2 adult bulls and 3 adult cows to Nunivak Island, where they will be released as the nucleus for building up a musk ox herd on this reservation. As the original herd grows in numbers and funds become available, it is planned to distribute the animals to other favorable localities as a means of building up separate herds, thus reducing the possibilities of losses from epizootics.

#### REINDEER, CARIBOU, AND OTHER WILDLIFE

Studies were made of reindeer, caribou, and associated grazing problems. Range reconnaissance work on plants for wildlife food was continued, and information was assembled regarding the status of waterfowl and other game birds, big-game animals, and fur bearers in various sections. A marked increase of certain birds, rodents, and rabbits was observed locally in the Territory, and it seemed apparent that the upswing in the cyclic abundance in these forms was in progress, following a period of scarcity.

A publication entitled "Raising Reindeer in Alaska" was issued during the year (Misc. Pub. No. 207); a plan for the management of the brown bear in relation to other resources on Admiralty Island was published in cooperation with the Forest Service (Misc. Pub. No. 195); and a comprehensive report on the Alaska-Yukon caribou was completed and at the end of the year was in course of publication as North American Fauna No. 54.

### SCIENTIFIC REFERENCE COLLECTIONS AND RECORDS

Continued progress was made in assembling and recording biological data based on collections of specimens and reports regarding life histories, habits, and distribution of mammals as well as of birds. During the fiscal year 113 mammal specimens were added to the Biological Survey collection, and 758 were identified for 34 institutions and individuals in 19 States and 1 foreign country. Specimens to the number of 120 have been borrowed for study from 8 institutions in 6 States and 1 foreign country, whereas loans were made of 1,651 specimens to 10 institutions and individuals in 9 States and 1 foreign country. The facilities of the mammal laboratories were utilized by 30 re-

search workers from 15 States, Alaska, and 2 foreign countries. Scientists of the Bureau, using these collections, described two new mammals, belonging to the genera *Reithrodontomys* and *Neotoma*. Mammal type specimens in the collection now number 908.

During the year, 662 bird specimens were added to the collections, chiefly from North Carolina, Georgia, and Virginia. Technical studies and identifications of 705 specimens were made at the request of museums, educational institutions, other organizations, and research workers, including members of the Bureau staff and others studying economic problems, and 340 specimens were lent to specialists engaged in technical regional studies of faunal problems. Assistance also was given many ornithologists who were preparing State or regional reports for publication.

Of outstanding importance among technical reports on selected groups of areas were the completion for publication of a report on the mammals of Oregon, based on many years of investigation, and of a manuscript embodying research on the classification and distribution of the economically important group of American ground squirrels (genus *Citellus*). Progress has been made on a technical revision of the mountain lions and on a taxonomic and distributional study of arctic hares.

In connection with efforts now being made to restore land and water areas that have been unwisely drained or put to other agricultural uses, there has been an urgent demand for dependable information regarding the occurrence and distribution of the wildlife species affected. The files of information assembled by field naturalists and laboratory workers of the Biological Survey for 50 years contain a vast fund of information regarding the former and present status and the ranges and movements of practically every known species of North American bird or mammal. Several million card records, systematically arranged, have proved of the utmost value in connection with the preparation of a special series of maps of the present and former ranges of important species.

Based partly on birdbanding operations, partly on special field studies during the past 2 years, and partly on data previously assembled and classified in the Bureau's files, there were published during the year a circular (no. 342), on The Waterfowl Flyways of North America, and a publication (Misc. Pub. 210), on the Status of Waterfowl in 1934. A motion-picture film also was completed and released under the title "Flyways of Migratory Waterfowl." A series of lectures on wildlife and conservation topics by a Bureau ornithologist over a period of 4 months in 21 States also served to give the public a better understanding of the program and accomplishments of the Survey and met a distinct demand.

## ECONOMIC STUDIES OF WILDLIFE

### INVESTIGATIONS OF WATERFOWL FOOD RESOURCES

#### EFFECTS OF MOSQUITO CONTROL ON WILDLIFE HABITAT

Naturalists of the Bureau devoted much effort during the year to determining the effects of mosquito control and drainage projects on waterfowl food and cover. Such projects have been undertaken all over the country as a means of providing relief labor. In many instances the work was done without proper consideration of wildlife interests or adequate supervision, and valuable forms of wildlife have suffered. Some of the most destructive results occurred where good waterfowl areas were needlessly drained under the guise of mosquito control. Vigorous efforts have been made to prevent unnecessary undertakings and the further destruction of the food resources of valuable aquatic forms of wildlife. Attention has been given to harmonizing these activities with wildlife interests, to conserving marsh and aquatic habitats, and to devising means that would permit mosquito control where needed and at the same time save wildlife habitat. The destructive effects have been due chiefly to fluctuation of water levels beyond the limits the most desirable plants can tolerate, and so lowering the water levels as to expose wigeongrass, sago pondweed, and other submerged plants to the direct rays of the sun and consequently to kill them. In such areas other marsh plants usually utterly useless or of less food value invade the land. Recommendations have been made that, where possible, water levels be controlled through the use of sluices, flood gates, or head gates, or by other means.



## CHESAPEAKE AND ALBEMARLE CANAL LOCK

The experimental opening of the lock in the Chesapeake and Albemarle Canal, at Great Bridge, Va., permitted resumption of the flow, once checked, of polluted saline waters from Norfolk harbor into Currituck Sound, N. C., and Back Bay, Va. Investigations disclosed the fact that the progressive improvement of aquatic plants following reestablishment of the lock in 1932 had been overcome, and that conditions for waterfowl had grown steadily worse. On the basis of the Bureau's findings, which were presented at a public hearing in Norfolk on June 21, 1935, the War Department decided to maintain the lock in normal operation as a guard against further pollution.

## WATERFOWL FOOD CONDITIONS ELSEWHERE

Investigations were continued to determine precise water conditions with reference to salinity, alkalinity, and acidity associated with the growth of certain important waterfowl food plants. Studies were made in the sand-hill section of Nebraska, the Panhandle of Texas, and in North Carolina, Washington, and Oregon.

Studies also were made of eelgrass, formerly the principal food of sea brant and an important food of other waterfowl along the Atlantic coast. Reliable information was obtained regarding the situation and made public in a mimeographed leaflet of the Bureau (BS-3) under the title "The Present Situation Regarding Eelgrass, *Zostera marina*."

During the year biological surveys were made of proposed waterfowl-refuge areas with respect to their food resources, availability of food and cover, water conditions, and general suitability, in every State except Michigan, Kentucky, Wisconsin, and Utah. Reports were submitted and recommendations made for improving conditions where necessary.

## CONTROL OF UNDESIRABLE WATER PLANTS

The rapid spread of the introduced water caltrop (*Trapa natans*) in the Potomac River has been the cause of deep concern. In some places the plant has increased to such an extent as to hinder navigation and has smothered out many acres of valuable wild-fowl food plants. It was recommended that the plant be eliminated as speedily as possible. Funds and labor were made available through the Civilian Conservation Corps and the Division of National Capital Parks of the National Park Service to construct a fleet of flat-bottomed boats and to design an aquatic mower. Experiments with chemical sprays and mechanical methods, begun last summer, were continued during the growing season. The Bureau recommended that work should be undertaken, beginning at Washington and proceeding toward the mouth of the river, to eradicate the plant completely. Members of the New York Conservation Commission have consulted with Bureau specialists concerning the possibility of eradicating water caltrop from the Schenectady area also.

The course run by water caltrop from adventitious introduction to the status of a serious pest should be considered when any aquatic plant of negative value as a wild-fowl food is observed in a new area. Such new aquatic or marsh plants should be immediately appraised and, if extirpation is decreed, drastic action should be taken. An illustration is the recent discovery in the Potomac at Washington by a member of the Bureau's staff of a small stand of giant cutgrass, or southern wildrice (*Zizaniopsis miliacea*), a plant that affords a minimum of food and only fair cover for wild fowl, and, where it makes a stand, inevitably replaces wildrice and other more valuable waterfowl food plants. Steps were taken to eliminate the entire patch of this possible pest the day after it was observed.

## LABORATORY WORK ON FOOD HABITS OF WILDLIFE

## STOMACH ANALYSES ACCOMPLISHED

The work of stomach-content examination, which forms the basis for much of the economic work of the Bureau, suffered materially by the necessity of diverting trained men to field surveys of proposed refuge sites and to studies of waterfowl breeding and feeding grounds. Stomach analyses in the Washington laboratory, however, included those of 806 birds, 197 mammals, and 3 reptiles, in addition to identification of the contents of 156 owl pellets. In

the Food Habits Research Laboratory at Denver, Colo., 11 pellets of white-necked ravens and 83 fecal samples of the coyote were analyzed, in addition to contents of the stomachs of 337 birds, including 90 white-necked ravens and 103 crows, and stomachs of 4,561 mammals, including 3,680 coyotes and 613 bobcats.

Examination of the stomach contents of all diving ducks on hand has been completed, and the work of tabulating the information on their economic relationships is in progress, preparatory to publication. Statistical compilations have been completed for a report on fish-eating birds, the first section of which, concerning the herons, is now being prepared for publication. A manuscript for a technical bulletin on the food habits of the woodcock, snipe, dowitcher, and knot was brought to date through the examination of additional stomach material.

The stomach contents of 50 woodcock and 38 tree sparrows were determined for monographic studies being made on these birds. Besides these, numerous other minor examinations for outside agencies were made. Several stomach examinations and identifications of fur and flesh were made in connection with State and Federal game-law violations. In connection with a legal process in Louisiana, it was necessary to examine 24 stomachs of the blue goose and to tabulate the food of 18 species of ducks, geese, rails, and shore birds. Laboratory experiments were undertaken to determine the relationship, if any, between lead-shot poisoning and the quantity of grit in waterfowl stomachs.

#### ECONOMIC STUDIES REPORTED ON

An economic study, *The Crested Myna, or Chinese Starling, in the Pacific Northwest* (Tech. Bull. 467), was published in April, with the recommendation that the bird should be discouraged from coming into the United States from British Columbia, where it is now established. It appears to have more objectionable habits than its close relative, the European starling, and serious economic consequences are anticipated if it should be permitted to become established in fruit-growing sections of the West.

A publication (Circ. No. 348) containing discussion of the food value, together with descriptions and illustrations of the quail-food plants of the Southeastern States, was published for the guidance of persons wishing to improve environments for bobwhite quail.

Continuing a study requested by the American Society of Mammalogists, there was prepared and published in the *Journal of Mammalogy* for November 1934 an article, *Winter Food Habits of the Coyotes: a Report of Progress, 1933*, and a manuscript was prepared on the fall-winter food habits of coyotes. Sufficient material to permit the completion of reports on the spring and summer food habits of the species is now available.

The work on the collection of mammalian hair, which has continued most successfully, was reported upon in an article, *A Simple Method for Sectioning Mammalian Hairs for Identification Purposes*, published in the August 1934 issue of the *Journal of Mammalogy*. One of the most interesting cooperative tasks of the year was the identification for the Museum of Northern Arizona of rabbit fur taken from the 1,500-year-old grave of a Basket Maker Indian. Another interesting examination was that of intestinal material of a mummy taken from a cave in Arkansas, in an effort to learn something of the food habits of early aborigines of this continent.

In cooperation with the conservation department of New York, the stomachs and crops of 80 ruffed grouse were examined and the findings embodied in a mimeographed leaflet (BS-1) entitled "Winter Food of the Ruffed Grouse in New York", initiating a Bureau series of wildlife research and management leaflets to present current information as developed. Another leaflet in this series (BS-11), based on stomach analyses of various species, was issued under the title "Birds Aid Blueberry and Cranberry Growers."

#### COOPERATIVE INVESTIGATIONS

Economic studies of predatory animals and birds in Virginia, Michigan, Texas, and Colorado were carried on as a part of a general cooperative program. Assistance was rendered the University of Wyoming in outlining a detailed life-history and game-management study of the sage hen and in examining the crops and gizzards of 33 birds. Knowledge of the food habits of the scaled quail has been advanced during the year by analyses of 128 stomachs, 14 of



these for the southwestern game-management project. In cooperation with the Virginia Commission of Game and Inland Fisheries, the stomachs of 45 gray and 2 red foxes were examined; as also were those of 1 gray fox, 13 red foxes, 48 coyotes, and 7 bobcats for the Michigan Department of Conservation. The contents of 83 fecal masses of coyotes were identified for the National Park Service. For the Hawk and Owl Society, 100 pellets of the barred owl were examined; and 40 of the short-eared owl for the Texas Christian University.

#### PRACTICAL IMPORTANCE OF LABORATORY WORK

Lists of foods thought by field observers to be important for upland-game birds were submitted with two series of crops and stomachs collected in different localities. After the material had been examined the lists of actual foods, in order of preference, were compared with lists made in the field. The results are worthy of serious consideration when recommendations for upland-game-bird foods for one section are made upon the basis of food eaten in another, though neighboring. It was found that about half the plant foods listed in the field as important did not form an important article in the diet, while less than half the foods that were important had been listed in the field and many of the major food items had been overlooked there. These studies confirm the stated policy of the Bureau, that specific economic status must be determined individually for each region concerned and at different seasons and under varying conditions, rather than depending upon generalizations for the whole country, on the basis of limited local material. They show also how indispensable laboratory stomach analyses are as a supplement to field studies and confirm the conclusion that in determining food preferences for most species, laboratory examinations are more accurate than field observations. A comprehensive statement on the value of research into the food habits of wildlife was published in the hearings on the agricultural appropriation bill for 1936 (pp. 717-737) and reprinted for distribution by the Bureau.

#### FOOD OF UPLAND GAME

A survey of wildlife food and cover conditions on the Norris Dam area was made for the Tennessee Valley Authority, to which agency a report was submitted, including lists of desirable game-food plants, suggestions on propagation methods, and lists of sources for restocking with wildlife. A survey of the available game foods in State forests of Tennessee also was undertaken at the request of the State forester, and recommendations were made for improvement of the food supply. The Survey has continued as a cooperator in the series of experimental upland-game-bird projects initiated several years ago in Arkansas, Oklahoma, Indiana, and South Carolina. From these it has obtained valuable information on management practices relating to quail and lesser prairie chickens.

Various upland-game-management projects have been furthered through cooperation with individuals, universities, State game commissions, and other institutions by laboratory examination of crop and stomach contents of birds or mammals and by identification of the specific food items submitted. The stomachs of 15 elk and 48 deer from two western parks were examined at the request of the National Park Service, and 18 stomachs of upland-game birds were analyzed for the Soil Conservation Service in connection with studies to gather information for the correlation of soil-conservation practices and game management.

A catalog of trees and shrubs useful to wildlife as food and cover and suitable for planting in each of the States included in the Great Plains shelter-belt was prepared and submitted to the Forest Service.

#### RELATIONSHIPS OF PREDATORS AND UPLAND GAME BIRDS

During May and June a field investigation was carried on in Virginia to determine the extent of fox depredations upon nesting game birds, during which 35 ruffed grouse and 78 bobwhite quail nests along with 20 fox dens were kept under observation. The extent to which foxes destroy game-bird nests has been much in dispute.

Observation of the biological relationship between predators, bobwhite quail, and rodents on a Virginia game farm was continued. Examination of 46 predator stomachs indicated that the foxes, house cats, and birds of prey were

taking meadow mice almost exclusively. These rodents had become unduly abundant on the area as a result of improved food and cover conditions incident to game-management practices. A survey was made of five Texas sheep ranches enclosed for periods varying from 5 to 15 years by coyote-proof fences. Even in these areas the bobwhite quail had decreased because of the scarcity of nesting cover coincident with overgrazing.

#### FIELD STUDIES OF INJURIOUS BIRDS

There is a constant need for research in bird control and for developing methods to make it less necessary to destroy bird life. Selective and specific measures for control are an urgent necessity, and considerable time has been devoted to a solution of important control problems.

#### CROW-DUCK RELATIONSHIPS

The field investigation of crows in relation to nesting waterfowl, carried on in the Prairie Provinces of Canada in the summer of 1934, was resumed in May 1935. When the work in Saskatchewan for 1934 was completed it was found that approximately a third of all duck nests under observation on a single marsh had been destroyed by crows. Because of peculiar local conditions and an unusual concentration of the nesting birds there, another representative area in the vicinity of Cooking Lake, Alberta, was selected for the 1935 season's work. Though nesting histories are incomplete, the data indicate that a large number of eggs were pilfered by crows. With the present reduced duck population it appears that effective control of crows during the breeding season will be necessary on many waterfowl-nesting areas. Laboratory studies of the stomachs of crows collected on the Cooking Lake area indicated that 4 percent of the diet of the adults and 10 percent of that of the nestlings consisted of bird and egg material. Correlated with these findings was the observation that again approximately a third of the duck nests in the vicinity had been destroyed. This information may prove to be an important index to interpreting the degree of depredation by crows in any given area, as determined by stomach examination. Experimental work on crow control was carried on in Alberta, and also in Oklahoma for 1 month in winter. Particular attention was paid in the winter study to bombing, trapping, and the development of a selective poison.

#### WHITE-NECKED RAVEN CONTROL

The control of the white-necked raven was advanced by field experimentation involving trapping and baiting and by laboratory study to determine food preferences. Information on the life history of these birds was collected, and the nature and extent of their depredations on peanut, melon, and pecan crops in Texas and New Mexico were ascertained. The results have been incorporated in a manuscript to be issued as a mimeographed leaflet describing a cage trap.

#### WATERFOWL DEPREDACTIONS

Wild ducks were accused of causing injury to various interests both in the East and in the West. Investigation of complaints by fishermen in Massachusetts that elder ducks were feeding heavily on scallops showed that these birds, though feeding over the scallop beds, were actually utilizing noncommercial shellfish, but that white-winged scoters were feeding on scallops and other commercial forms. Because of these findings regulations were adjusted so as to reduce destruction of the elder ducks.

On Long Island, N. Y., after the open season, the discontinuance of baiting during an exceptionally severe winter forced many black ducks to find food in strange places, even in chicken yards and at fish ponds. Black ducks gaining access to a trout hatchery through a hole in the protective netting ate practically an entire trout crop, consisting of about 20,000 small fish. Complaints of duck and goose damage to grain crops in various sections may also be considered an aftermath of baiting.

Investigations were made to devise means of frightening waterfowl from crops without injury to the birds. These studies have resulted in the preparation of a leaflet on the relationship of waterfowl to crops, including recommendations for reducing both crop damage and destruction of birds.



## HERON DEPREDATIONS

Black-crowned night herons have afforded a frequent source of complaint, not only because of their fish-eating propensities and predatory relationships to other forms of wildlife, but also because of their habit of colonizing in close proximity to houses. Two complaints against these birds, one in Massachusetts and the other in New York, were not sustained upon investigation, while limited control was approved in one instance on Long Island. Investigation of a complaint that these herons were destroying duck nests in the Lake Erie marshes exonerated them and fixed the blame upon skunks, crows, and house rats. Prompt and simple remedial measures prevented further losses and needless destruction of the herons. Depredations of "bitterns" at a fish hatchery in Nebraska proved to be largely the work of immature black-crowned night herons. The recommendations made by trained field men when compared with the action requested by the complainants confirm the wisdom of the policy of having Bureau representatives investigate reports of depredations whenever feasible, and devise methods for preventing losses.

## BIRD DEPREDATIONS IN CALIFORNIA

The need for studies of the control of injurious birds in California continues, though the species causing the most damage may vary both locally and seasonally. Linnets and horned larks still occasion much injury to fruits, truck crops, and seedlings. The horned lark was the subject of considerable study in cooperation with county agricultural commissions to develop baiting methods for selective control. Wherever possible preventive rather than control measures were applied. This year blackbirds receded from the place of prime importance in the depredation picture. The crow, however, was responsible for considerable losses in almond groves, and English sparrows as well as native sparrows of the "crowned" group (*Zonotrichia*) caused significant damage by pulling up or devouring seedlings.

## RESEARCH IN FUR PRODUCTION

## FUR ANIMALS IN THE LAND PROGRAM

Fur animals, one of the most valuable natural resources of this country and one of the most sadly neglected and atrociously wasted, must have consideration in establishing policies for land management. The annual turn-over in the retail fur trade has shrunk from \$500,000,000 in 1929 to \$150,000,000 for the past year. The information collected shows that this shrinkage cannot be attributed wholly to drought, floods, and the financial depression, but that it results in part from an actual scarcity of fur animals. To what extent this is due to overtrapping and failure to preserve natural habitat is not definitely known. Information is not available to show whether 10,000,000 or 15,000,000 muskrats are being produced while 13,000,000 are being trapped, and yet under a good business management of fur bearers the first thing to be determined is the number of the different species produced and killed annually on such areas as remain available. The Bureau has encouraged State game agencies issuing trapping licenses to obtain laws requiring reports of trappers, so that the individual States might calculate the numbers and kinds of their fur animals taken annually. This would make reliable estimates possible on the total annual take in the whole country. At present 7 States require trappers to report their catch and 19 compile data from various sources. Definite and practical policies of management, involving the preservation of hereditary habitat, must be established to insure a permanent supply of fur animals.

The Bureau has continued to compile such data as are available on the number of trappers and the number of fur animals taken in the various States. To assist in arousing a public sentiment to care properly for the valuable natural resources represented by fur bearers, the Bureau has issued a mimeographed abstract of State laws on trapping seasons. It has also encouraged the movement inaugurated by a few States for the issuance of separate hunting and trapping licenses to replace the combination trapping, hunting, and fishing licenses, so that funds accruing from hunting and trapping may be expended to develop the resource from which derived and the preservation of breeding grounds. Such funds would assist in developing and managing the fur resources on a sustained-yield basis.

Investigations show that many swamps and marshes are havens for muskrats and other fur animals as well as for migratory waterfowl. Some tidal

and inland marsh areas are capable of producing in addition to other wildlife five muskrats to the acre, sometimes more. At present market prices, muskrat pelts alone may yield \$7 to \$14 an acre each season. Such land should be left undrained, as no other system of cropping would produce as much as can be realized in direct and indirect returns from the wildlife. The large majority of trappers are farm boys and farmers. The employment thus furnished and the income supplied to the rural population are sufficient justification for arousing public sentiment to save what is still left of our fur resources and their habitat, and to build up the supply on a sound business footing. The fur trade has been encouraged to cooperate with local, State, and Federal agencies in fostering constructive policies, so that fur animals may be conserved rather than ruthlessly exploited. The Bureau's warnings on fur depredation in the wild were epitomized in a short article in the 1935 Yearbook of Agriculture (pp. 218-220), under the title "Fur Scarcity Through Overtrapping Impends; Conservation Needed."

#### PROGRESS IN FUR FARMING

Raising fur animals is an important and profitable farm operation, not only in supplementing the natural supply but also in using land of little value for crops. No branch of animal production has developed more rapidly during the depression or resulted in greater profits than silver fox farming, and this at a time when some farm commodities scarcely had a market. The investment in fur farming is now estimated at \$50,000,000. Fox farmers in 1934-35 harvested 170,000 pelts, having a total value of approximately \$7,000,000. They have demonstrated their ability to repay Federal loans made upon the Farm Credit Administration's approval of silver foxes as eligible security. Commercial concerns that advanced feed to fox farmers on such credit report practically no financial losses therefrom.

Fur farming is now established in 35 States and is not in competition with any other type of farming. The industry is organized, with 3 national, 15 regional, and 16 State associations. A list of these was published during the year in a Bureau mimeographed leaflet (Bi-1357).

#### THE PROBLEM OF TINGE

During recent years the quantities of tinged, or brown-colored, fox pelts have increased to an extent to cause concern among fox farmers and fur tradesmen. Research is the only means of discovering the causes involved. As foxes are raised primarily for their pelts, the quality of fur must be given first consideration, and other things being equal, the clear-colored pelts bring the best prices. All the silver fox pelts produced at the United States Fur Animal Experiment Station are being graded and appraised by the most competent judges in the fur trade, in order to obtain definite information on skins produced under controlled conditions and from animals whose breeding is known, and to learn the importance of several possible causes of tinge, including heredity, feed, sunlight, climate, and methods of handling. Continued tests at the station show that the use of furring sheds is an important means in controlling tinge, especially under the practice of placing the foxes in these sheds 5 to 6 months before pelting.

#### SURVEY OF THE FUR INDUSTRY

A comprehensive survey of the fur industry of the United States is being made by the Hudson's Bay Co., which has been engaged in the fur business for more than 250 years. In the absence of a central organization of the fur trade from which to obtain statistical data, the company turned to this Bureau for assistance. All available information was given, and in return the company will supply the Bureau with a copy of its report.

#### FUR ANIMAL EXPERIMENT STATION

##### FEEDING EXPERIMENTS

Experimental work designed to aid fur farmers to reduce costs of feeding, breeding, and general management is of vital importance to the industry. Experiments with substitutes for raw meat in rations have been continued at the United States Fur Animal Experiment Station, at Saratoga Springs, N. Y. This research is now of exceptional importance because of the rise in meat prices. Ordinarily 40 to 60 percent of the ration fed to foxes is composed of meat and meat byproducts, and increased cost of feed is a practical



concern to fur farmers because of its effect on production costs. There was a considerable saving in the cost of feed when 5 parts of dehydrated beef meal and 1 part of liver meal were substituted for the raw-meat portion of the ration for lactating vixens and for pups. There was no difference in the number of vixens that whelped young or in the size of litters in two test groups of foxes. Those receiving the substitute seemed to have no milk at the end of 6 weeks of the suckling period, while those receiving meat had a normal secretion during the entire suckling period of 8 weeks. Weaned pups fed the same rations showed no appreciable difference in growth, quality of fur, or general health. A slight difference was noted in food consumption and growth in favor of the meat ration, but it cost almost twice as much to feed a pup the meat ration as the substitute.

An experiment to determine the value of digester tankage, a common and easily procurable packing-house byproduct, in conjunction with liver meal as a substitute for the raw-meat portion of the ration is now under way. Meat scraps, or meat and bone scraps, also will be tested to determine their value as a substitute for raw meat. The experiments have been planned to include feeding tests during breeding, gestation, and lactation periods of vixens, the summer maintenance period for mature foxes, and the developing period for pups. Attempt also has been made to find suitable readily procurable cereals or cereal products both cooked and uncooked that can satisfactorily replace the constantly diminishing byproducts formerly obtained from breakfast-food manufacturers.

Experiments were undertaken near the close of the fiscal year to determine the value of various meat substitutes also in feeding mature and young minks.

#### FOX-BREEDING EXPERIMENTS

In recent years with the popular demand shifting from the darker silver fox pelts to those classed as three-fourths and full silvers the trend has been to select the more lightly silvered foxes as breeders. To meet the constantly shifting market demands as to the degree of silvering in fox pelts it is important to determine the genetic basis of silvering. A breeding experiment was begun this year to isolate the genetic factors so that market requirements might be met promptly.

To supplement this experiment data are being compiled on the number of silver-fox pelts produced annually in the United States, and more particularly on the relative percentage of pelts falling in the various degrees of silver. This will afford opportunity to follow the trend of the market more closely and to keep fur farmers informed of the progress being made in methods of meeting changing demands. An article on the use of elevated wire floors as a practical means to prevent lungworm infestation of foxes was prepared and published in the *Journal of the American Veterinary Medical Association*, in April 1935.

#### RABBIT EXPERIMENT STATION

##### FEEDING AND BREEDING STUDIES

Experimental work conducted at the United States Rabbit Experiment Station at Fontana, Calif., has been designed to improve feeding and management practices in commercial rabbitries. Feeding experiments were concerned with factors affecting molt and rate of hair growth; economical production of fryer rabbits; and the value of succulent feed, salt, and cod-liver oil as constituents in the rations.

In a definite breeding program pursued for selecting and reproducing rabbits possessing superior germ plasm, some exceptional results have been obtained. Eighty-nine pounds of marketable rabbits, averaging in weight 4.46 pounds at 8 weeks of age, were developed from three liters of a single doe, in the 234 days from the breeding date of the first litter to the weaning of the third.

Four experiments conducted on rations over a period of 2 years were completed, the first designed to learn the effect of varying quantities of protein on the production of does; the second to determine the relative feeding value of oats, barley, wheat, and corn; the third to compare a method of feeding mash and hay with that of a complete ration in pellet form for developing does; the fourth to determine feed consumption and cost of 13 different rations. Carcass values, distribution of commercial cuts, and value of fur according to age, season, and breeding were other factors considered in this experiment. Data were obtained on 700 rabbits slaughtered at 6 pounds live weight. The pelts,

both in the raw state and after they were dressed and dyed, were graded and appraised by experts in the trade. Progress reports were furnished rabbit breeders, fur tradesmen, and others desiring this type of information. An exhibit at the Los Angeles County Fair, demonstrating the work of the station and more particularly the nutritional value of rabbit meat, was favorably commented upon in the press and in rabbit periodicals published in the United States and abroad. A new *Farmers' Bulletin* (no. 1730), *Rabbit Production*, was issued during the year.

#### SELF-FEEDER EXPERIMENTS

A self-feeder suitable for rabbits has been developed at the Rabbit Experiment Station, and approximately 100 are being used in experimental feeding to improve certain details, preparatory to recommending it for general use in the industry. The rabbit seems to have ability to balance its own ration if allowed to select from the proper kinds of feed. Most encouraging results have been obtained, and it is believed that the self-feeder will assist materially in determining the proper proportions of grain and roughage, the most desirable nutritive ratio, and the kinds of feed best suited for use during the gestation, lactation, and maintenance periods. The basic data being accumulated will serve for developing a feeding standard for rabbits comparable with those already formulated for various kinds of livestock. As rabbits will not readily consume finely ground feeds, plant-protein supplements, such as peanut, cottonseed, linseed, sesame, and soybean meals, have been adapted to self-feeding by molding into pellets three-sixteenths of an inch in diameter and one-eighth of an inch long without addition of moisture. The rabbits showed little preference for any one of these meals when it was ground to the same degree of fineness, but when fed in the form of pellets to 150 rabbits of various ages over a long period, the peanut-meal pellets were found to be by far the most acceptable; sesame was second choice; and no great preference was indicated among cottonseed, linseed, and soybean pellets.

#### FACTORS INFLUENCING "BLOAT"

"Bloat" continues to be a serious concern of commercial rabbit raisers, some producers reporting losses as high as 72 percent in young rabbits. Previous experimental work at the Fontana station has indicated that bloat is neither infectious nor contagious. Feeding tests with California alfalfa hay cured and baled under careful supervision, with alfalfa hay shipped from the Midwest, and with Sudan grass hay indicate that the roughage portion from the ration is not the major cause of bloat. At present the form in which the grain is fed—that is, whole, rolled, or soaked—and the possibility of an iron deficiency as a contributing cause are receiving particular study.

#### FUR INVESTIGATIONS ON BIRD REFUGES

A number of refuge areas acquired primarily for conserving migratory waterfowl provide excellent fur-animal habitat, and under proper management can increase fur production with little expenditure of public funds. Crescent Lake Migratory Bird Refuge, Nebr., has furnished for study a complete series of muskrat pelts over a 2-year period. Studies of morphological and physiological factors have been undertaken with muskrat pelts from this and from a number of other refuges, to establish the prime-fur period, and a report on the findings will be prepared for publication. Efforts will be made to broaden this field of research on refuges where fur animals are considered an important resource.

#### COOPERATIVE STUDIES

##### KARAKUL-FUR INVESTIGATIONS

The general character of Karakul lambs produced during the past year in cooperative experiments with the Bureau of Animal Industry, at Beltsville, Md., shows considerable improvement, in both quality of fur and conformation. The most desirable purebred ewe lambs are being retained to develop a larger breeding herd. Skins of purebred lambs possess the most desirable luster, curl, and character, and are declared by the fur trade the most valuable, although pelts possessing considerable quality are occasionally produced from crossbred animals. During the year 10 purebred Karakul, 15 Karakul-Highland cross, and 15 Karakul-Corriedale cross lambs, ranging from 1 to 4 days of age, were pelted at Beltsville. The pelts will be carefully inspected and graded, and the information obtained will be useful in selecting breeding animals.



## FUR-STORAGE EXPERIMENTS

A cooperative experiment has been continued with local fur-storage concerns and the Bureau of Entomology and Plant Quarantine to determine the relative values of various storage methods and their effects on furs and linings. During the year 20 rabbit skins, dressed and dyed various colors, 4 muskrat (Hudson seal), 8 Russian squirrel, and 3 Persian lambskins were stored, after being marked for identification and cut into halves, thirds, and quarters. Some of these, together with various samples of linings used in fur garments, have been placed in cold-storage and fumigating vaults, and some are being cared for by the old chest-and-moth-ball method. The experiment has now been in progress for 2 years.

## EMBRYOLOGICAL STUDIES

During the latter part of the year an embryologist studied the reproductive organs of selected coyotes, wolves, mountain lions, muskrats, and other fur animals, to obtain more definite data on breeding and gestation periods. This information is needed in fur-farming operations and in making recommendations regarding trapping seasons. The study is a cooperative undertaking with the Carnegie Institution of Washington, and the laboratory work is performed at the Johns Hopkins University, Baltimore, Md.

## DISEASE-CONTROL INVESTIGATIONS

## PERIODIC FLUCTUATIONS OF WILD SPECIES

Investigations have been continued on the nature of the pronounced cyclic disappearance and return to abundance of important game species, which are frequently independent of weather conditions and food supply. When circumstances favor their spread, many infectious diseases are prevalent among these groups and become highly destructive over wide areas. It appears probable that the periodic decimations are due to several factors, among which disease is important.

These studies, carried on largely with the cooperation of the University of Minnesota and the Minnesota Conservation Department, are unique in their plan, in that the relative percentage of infected animals on a given area is computed on the basis of samples collected throughout the year. Careful counts and identifications of parasites are made, and conclusions as to their relationship to the spread of disease are based on the actual isolation of disease germs found both in the parasites collected from animals and those free on vegetation, awaiting opportunity for attachment to a suitable host. The action of parasites in the transmission of disease has long been known, but these studies indicate an intimate relationship between the abundance of certain ectoparasites and the rapid spread of epizootics among wild forms.

The significance of the role of wildlife disease was discussed in two mimeographed leaflets (BS-5 and BS-9, respectively) under the titles, "Tularemia, an Animal-Borne Disease", and "Infectious Disease as a Cause of Loss in Wildlife", and in two articles in the 1935 Yearbook of Agriculture—"Predators and Rodents are Factors in the Spread of Disease" (pp. 284-286) and "Botulism is a Factor in the Decrease of Western Waterfowl" (pp. 140-143).

## FUR-ANIMAL LOSSES

Diseases continue to take an important toll not only among animals in the wild but also on fur farms. Through information developed by the Bureau, in cooperation with the University of Minnesota and individual fur ranchers, some infectious diseases known to cause excessive losses are well under control, though other infectious agents not yet under control are found capable of entailing heavy damage. Continued studies correlating losses on fur farms with infections found in wild fur bearers make it apparent that many of the diseases prevalent among ranch-raised stock are brought in from the wild. These diseases are shown to be dissimilar to those occurring among domestic animals.

In efforts to procure a cheaper food supply, many fur farmers have caused digestive irregularities that are difficult to differentiate from infectious diseases. A large proportion of the animals on a ranch are simultaneously affected, and the degenerative changes present in vital organs are confused with similar appearances caused by pathological organisms. Recent investigations indicate that the greater frequency of urinary calculi observed is due to errors in feeding.

Serious losses among foxes, muskrats, raccoons, and other wild fur bearers have been studied. Raccoon losses were traced to an infection with *Pasturella pseudotuberculosis*. Losses among muskrats on some of the most valuable trapping marshes have been found due to the same organism as well as to excessive parasitism. It has been shown that control of the latter condition may be largely effected by maintaining ample water levels on the marshes.

#### WATER-POLLUTION STUDIES

The possibility of developing more effective restraint on the sources of water pollution and of minimizing its injurious effect upon wildlife has stimulated further research on this subject. It has been found that while much of the chemical waste reaching in and waters can be so treated as to render it relatively innocuous, most industrial-waste products do not kill wild birds and mammals directly, but instead destroy vegetation on which they subsist and thus render large areas of their natural habitat useless.

This is not true of pollution by oil. This substance is released in such quantities in the streams and lakes adjacent to many cities as to be a constant menace to the waterfowl feeding and resting there. It is difficult to impress municipalities with the seriousness of this form of wildlife waste, since the films of oil thus spread upon the waters are so thin as to appear insignificant, and the losses of waterfowl occasioned by them may not be spectacular in any one locality. The total loss throughout the United States, however, is important.

Another form of pollution to which attention has been given is the menace of lead shot in marshes, which when eaten by birds feeding there cause fatal lead poisoning. Comparatively little attention had thus far been given to developing satisfactory control measures, because of inadequate funds, but during the past year the interest of workers of the University of Minnesota has been enlisted, and at present intensive research is in progress in an effort to develop a type of nontoxic shot.

### LAND-ACQUISITION SURVEYS AND NEGOTIATIONS

#### GROUNDWORK AND ACCOMPLISHMENTS

Shortly before the close of the fiscal year 1934, emergency funds aggregating \$6,000,000 were allocated to the Biological Survey for the acquisition of migratory-waterfowl refuges, and soon investigations were begun on 15 units. In previous work under the Migratory Bird Conservation Act the Bureau had assembled substantial facts regarding some of these, and it therefore became possible to begin negotiations for acquiring lands known to be desirable. Three outstanding cases were closed: Lake Mattamuskeet in North Carolina, containing 50,000 acres; the initial part of the White River Migratory Waterfowl Refuge in Arkansas, including 45,000 acres; and the Blitzen Valley unit in Oregon, containing 64,720 acres. In addition to these, Goat Island Migratory Bird Refuge, 21 acres off the coast of Oregon, was established by Executive order on May 6, 1935.

Other proposed units called for engineering studies over extensive periods, so that the full impetus of land-acquisition work did not make itself felt until about September 1934. Preliminary work, however, looking to negotiations for hundreds of small tracts within many of the prospective areas was begun with the limited experienced personnel early in the fiscal year and steadily gained in momentum as the force was expanded. By March 31, 36 units had been designated, valuation examinations were mostly completed, and negotiations were well under way for the purchase of the numerous tracts that were finally selected as desirable. By the end of the fiscal year there had been examined and appraised approximately 1,000,000 acres of land; and negotiations for the acquisition of 925,570 acres had been conducted and successfully consummated at an average cost of \$8 an acre (including approximately 12 percent of lands taken by judicial proceedings because of inability to reach mutual satisfactory price agreements or by reason of incurable defects in title). Details pertaining to the refuge units acquired and in process of acquisition are set forth under another heading (tables 2 to 5).

#### PROBLEMS INVOLVED

Some problems in the acquisition of migratory-bird refuges are unique, and many are more than ordinarily difficult. It is imperative that all lands within a given administrative unit be owned in their entirety by the United States



so that the refuge may be administered effectively. The waterfowl to be protected move from place to place, so that any lands in alien ownership intermingled with Government-owned lands would not only interfere with development plans but would make effective protection of the birds impossible.

Prior to negotiations, all lands considered for acquisition were examined in detail by precise methods to classify them as to physical features, uses being made of them, crop-production capacity, and existing improvements. Great diversity of land-use types was found, 18 percent being devoted to grain-crop production, 11 percent to the production of hay, 30 percent to grazing, 20 percent to timber production, and 13 percent was marsh. In addition, the exterior limits of the units acquired contained a large percentage of natural water areas. The grain-crop lands are principally used for wheat production; other crops raised are corn, barley, rye, rice, and cotton. Certain units were primarily valuable because of their capacity for producing muskrats and other fur-bearing animals of importance but of relatively less economic value.

The revenue-producing capacity of the tracts, and thus their market value, was arrived at after exhaustive consideration of the factors involved. Negotiations for the acquisition of the many tracts embraced within the units were not instituted until after field investigations had been completed and a price structure for each land-use type in each unit had been determined and approved. These negotiations were conducted with more than 1,500 individual owners, and in each instance separate valuation determinations were reached for each tract. Many individual ownerships embraced from a few to 5 or 6 types of land; it therefore became necessary to determine the price consideration by finding the average value of all land-use types in each tract and of the improvements.

About 35 percent of the tracts desired were taken under contract with minimum difficulty, and approximately 50 percent involved protracted negotiations; but in about 15 percent price agreements could not be reached. This residue was held by owners unwilling to accept the price offered, or under ownership so involved or complicated that valid options could not be taken from the ostensible owners. It became necessary in such cases to resort to judicial proceedings.

The options for tracts that could be taken by agreement were, as quickly as received, sent to the ultimate approving authority, and after favorable action, title examinations were instituted for conveying the lands to the United States. Concurrently with the title examinations, the Biological Survey undertook cadastral surveys of the lands, to prepare adequate descriptions for use both in the deeds of conveyance and in demarcating the boundaries on the ground, in order to facilitate identity of the lands for administration and trespass-prevention purposes. By the end of the fiscal year, approximately 1,000 miles of boundary lines had been surveyed and the corners permanently monumented with concrete posts capped with bronze tablets suitably marked with Bureau of Biological Survey inscriptions.

The mere acquisition of lands for waterfowl refuges does not automatically reserve them for the purpose. The final step in each project has been the preparation of Executive orders to authorize the Department, through the Bureau of Biological Survey, to administer them as such. Thus to each can be applied all the previously enacted laws for the protection of wildlife and for the administration of such units for that purpose.

A specific formula for conducting land-acquisition negotiations cannot be laid down, and in each instance the method must be left largely to the strategy and good judgment of the negotiators. The problems attached to successful negotiations are numerous. The Biological Survey in dealing with landowners was restricted to the price levels it had established. After a commitment was made for the consummation of individual projects, the situation in each resolved itself into a seller's rather than a buyer's market, thus giving the landowner a decided strategic advantage in all transactions.

At the end of the fiscal year, the Biological Survey had taken under option and commitment 925,570 acres of land in 38 units but the title to all these has not yet been vested in the United States. Executive orders, however, have been prepared for 23 wildlife-refuge units. Fifteen other Executive orders and one proclamation have been prepared covering 5 administrative sites in Alaska and additions to 9 other existing refuges in the United States.

#### ENGINEERING AND BOUNDARY SURVEYS

Boundary surveys on 20 refuges and engineering surveys and operations for water improvement on others were completed or in progress at the close of the year.

## BLACKBEARD ISLAND WILDLIFE REFUGE

With Public Works Administration funds four lakes were created on Blackbeard Island Wildlife Refuge on the coast of Georgia. This was accomplished by driving four artesian wells that develop a flow of 2,400 gallons of water a minute. Earthen dams also have been constructed to retain the water, and suitable spillways to carry off the excess during periods of abnormal precipitation. These improvements make a resting and feeding place of great importance for the Atlantic-coast migrants, in a region otherwise practically destitute of fresh-water attractions.

## RAILROAD VALLEY MIGRATORY BIRD REFUGE

Some years previous to the establishment of the Railroad Valley Migratory Bird Refuge in Nevada several artesian wells had been driven on the public domain in this valley in exploring for mineral resources that never materialized. Some water, however, did come to the surface, and this produced several small marsh areas. Appreciating the possibilities of developing the subsurface water resources to the advantage of waterfowl, the Biological Survey, with Public Works Administration funds, made topographic surveys and with these data designed dams and dikes for the impoundment of the existing water supply, and supplemented this with six new wells. The eight ponds thus created now embrace 600 acres, and the number can be substantially increased with larger financial resources. This refuge, in an immense arid region, lies in the direct line of flight of migratory waterfowl. The improvement to food and water resources, while not yet so extensive as desired, will be a valuable contribution to waterfowl conservation.

## BIG LAKE BIRD REFUGE

The Big Lake Bird Refuge in Arkansas has for many years been under the administration of the Biological Survey, but instability of the water level, due to drainage enterprises on all sides, has reduced its value as a refuge. The Biological Survey has for a long time recognized the feasibility of correcting this situation, but not until funds were allotted could anything be done about it. During 1934 comprehensive plans were made and contracts let for the construction work to divert water into the refuge by means of canals and the construction of dikes to hold it at desired levels. Rapid progress was being made on this project until stopped by inclement weather last spring. Shortly before the end of July construction work was resumed, and it is anticipated that this project will be finished early in the fiscal year 1936.

## CRESCENT LAKE MIGRATORY BIRD REFUGE

Extensive topographical surveys were made on the Crescent Lake Migratory Bird Refuge in Nebraska, and investigations of surface and ground waters were begun. This work is to determine influences affecting changes in the lake areas and to assist in the conservation of the water resources of the refuge. The construction will add about 400 acres to the lake areas.

## UPPER MISSISSIPPI RIVER WILDLIFE REFUGE

The purchase of lands within the Upper Mississippi River Wildlife and Fish Refuge, under the provisions of the act that created it, has been brought to a virtual halt for want of funds. Through extensive acquisitions being made by the War Department for the development of the 9-foot channel of the Mississippi River, however, a great part of the lands still in private ownership is being conveyed to the United States, and adjustments satisfactory to both Departments in the matter of administration are being arranged. There will remain remnants of land valuable to wildlife conservation. Though in some instances not necessary to a completely rounded out administrative unit, these should be purchased by the Government as circumstances permit.

## BEAR RIVER MIGRATORY BIRD REFUGE

The Bear River Migratory Bird Refuge, Utah, is a functioning unit, but there are still lands within its borders title to which has not been conveyed to the United States. These lands are covered by an exchange agreement with the



owners, the accomplishment of which has been frustrated by difficult complications. The situation, it is hoped, is approaching a satisfactory conclusion through institution of judicial proceedings.

#### OTHER ACQUISITION WORK

Lack of funds has brought to a halt the acquisition of lands under the provisions of the Migratory Bird Conservation Act, but certain responsibilities under this act continue. Such land-acquisition personnel as could be carried has been used on the waterfowl-restoration program and on acquisitions previously discussed.

### THE MIGRATORY WATERFOWL RESTORATION PROGRAM

#### ESTABLISHMENT OF MIGRATORY WATERFOWL DIVISION

The order reorganizing the Bureau on July 1, 1934, contained the following definition of the scope of the Migratory Waterfowl Division:

A new division in the United States Bureau of Biological Survey is hereby established, which shall have as its specific responsibility the establishment and maintenance of a National Migratory Waterfowl Program. . . . A careful and thoughtful planning of refuges already owned and those to be acquired during the year and in the future is among the crying needs, both for the efficient functioning of the Bureau in the interests of the migratory birds and in the interests of the public and the sportsmen.

The immediate emergency-acquisition program brought about by allocation of special funds for refuge purposes, drought relief, and submarginal-land retirement will constitute a considerable part of the work of the Bureau in the immediate future. The prospect of an annual fund from the sale of migratory-waterfowl hunting stamps for the purchase and maintenance of refuges requires the preparation of a continuing program. . . .

Plans for a national refuge-acquisition program must be followed by a studied use and maintenance plan for each refuge. A staff of refuge custodians trained in the requirements for adequate maintenance, service, and usage best adapted to the full utilization of the refuge principle must be forthcoming. These objectives will constitute the responsibility of the Division of Migratory Waterfowl.

Upon this new Division fell the immediate responsibility of formulating plans for carrying out the expenditure of a total of \$8,500,000 allocated from various emergency funds for relief of drought-stricken and distressed agriculture and the restoration of extensive marsh and drained lake areas for the diminishing species of migratory waterfowl. No such large-scale operations for wildlife had ever before been contemplated in so short a period, nor had funds ever been available for so extensive a restoration program, although for some years the obvious need had been apparent of drastic rehabilitation of nesting grounds if the migratory waterfowl were to maintain a population adequate for even the restricted requirements of the sportsmen.

The President's Committee on Wildlife Restoration had previously brought to national attention the crisis faced by wildlife in general and, more particularly, the crucial fact that without breeding areas restored, there could be no regeneration of the rapidly receding population of migratory waterfowl. That committee's intensive dramatization of the need for wildlife restoration built up a national expectancy. The momentum thus attained, together with the tremendous volume of highly valuable and technical data assembled, became the heritage of the Biological Survey and the groundwork for the operations of the new division.

#### PERSONNEL PROBLEMS

One of the most serious obstacles to be overcome in instituting the waterfowl program was in the selection of suitable personnel. There was urgent need for trained hydraulic engineers, refuge reconnaissance biologists, and expert land appraisers and negotiators. Although the country was combed, it was difficult to get the handful necessary to start operations.

The lack of available technical men in hydraulic-engineering circles experienced at the outset was overcome through the cooperation of the Bureau of Agricultural Engineering, by which a skeleton force was found. So great was the stringency for trained instrument men, engineering aides, and others, that in the early stages of the program it was actually necessary to train this type of personnel. All engineering surveys and specifications were made and drawn up by the Bureau of Agricultural Engineering. That Bureau also examined and in most instances made topographic surveys and engineering estimates on a total of 54 major projects. In addition to this, it compiled voluminous data regarding watersheds, run-offs, artesian reservoirs, and kindred subjects pertaining to the water supply of the projects. The ability of the

Bureau of Agricultural Engineering to take over so large an assignment on short notice and its cooperation in these respects, were indispensable, and were tantamount to the successful institution of the program.

### THE REFUGE CONCEPT

In the initial stages, difficulty was experienced by the variation of the refuge concept in the mind of the interested public. Considerable work was done in combating various militant interests and educating them to the real purpose of a migratory-waterfowl refuge. This included the issuance in November of a circular (No. 339), A Program of Waterfowl Restoration, and publication in the 1935 Yearbook of Agriculture (pp. 330-331) of an article entitled "Waterfowl-Restoration Program Undertaken by the Government."

Migratory-waterfowl refuges are premised on the fact that although the main purpose is to maintain and produce game birds, each refuge will still present numerous utilization opportunities that have direct public benefits. Though it is planned to give the birds on all waterfowl refuges the requisite isolation and security, a large measure of social utilization of these areas is contemplated. Deep-water parts of the great storage reservoirs and adjacent beaches that are of limited use to waterfowl will be given over to public bathing, picnicking, and boating, and in almost all instances the refuges will supply fishing in sections where otherwise there would be practically no opportunities for this sport. The line of demarcation of the various uses, however, has been sharply drawn.

### TYPES OF REFUGES CONTEMPLATED

It was early recognized that the national and continental aspects of the migratory-waterfowl situation necessitated the establishment within the United States of three types of refuges: (1) Great nesting restorations in the northwestern breeding grounds; (2) intermediate resting and feeding refuges along the four great waterfowl flyways; and (3) large sections of the few remaining primitive marsh areas along the Gulf coast and in the southwestern border States, together with similar wintering areas on the Atlantic and Pacific coasts.

Because of the previous 6 years of drought conditions in the heart of the breeding grounds, because of the diminishing supply of birds in spite of heavy restrictions on bag limits and open seasons, and because of the almost total lack of breeding refuges of a national character, it was decided to begin the restoration program in the hereditary nesting range of the migratory waterfowl in the Northwest. This attack on the waterfowl problem has been found amply justified after 1 year's restoration activities by the preliminary indications of improvement noted in the great breeding areas within the United States during the 1935 nesting season.

### CONSULTING AND COOPERATING AGENCIES

Among the agencies more or less concerned in the institution of the waterfowl program were, in addition to the Bureau of Agricultural Engineering, already mentioned, the following: The Submarginal Land Program of the Federal Emergency Relief Administration; the Resettlement Administration; the War Department (Corps of Engineers); National Resources Board; Forest Service; Bureau of Indian Affairs; Reclamation Service; Bureau of Entomology and Plant Quarantine; Public Health Service; Bureau of Fisheries; State planning boards; State conservation departments; State agricultural colleges and universities; many conservation societies, leagues, and associations; irrigation districts; water users' associations; and private commercial companies or organizations.

In many instances the conflicting interests of one or more of these agencies were successfully mediated by the Biological Survey, or the waterfowl project was either enlarged or modified to give additional benefits to the State, the local people, or the agency particularly concerned. In many cases, the priority interests of an operating agency dictated a modification of the waterfowl plans so as not to injure or negate the activities of other agencies. In all instances, a harmonious and practical solution was found.

Contributory to the general migratory-waterfowl and wildlife program of restoration were the cooperation agreements with various agencies of the Government, arrived at through mutual understandings for more consistent operations in conservation. In fact, this year saw a quickening interest in wildlife problems in all Government agencies having large-scale field operations, including the Indian, Forest, and Reclamation Services.



One of the most encouraging instances of this sort was manifested by the Reclamation Service, which pledged its cooperation in the great task of biologically rehabilitating the large reservoirs of the West, which because of the drainage of many large areas of formerly ideal waterfowl marsh habitat, have grown to have a tremendous waterfowl importance. These reservoirs had been made wildlife refuges by Executive order, under the provisions of which bird protection is made secondary to their primary reclamation uses. It is possible, however, greatly to improve their value for wildlife by a few simple measures, such as fencing breeding grounds against their complete destruction by grazing stock, burning the tules at the right time of year, retaining a minimal water supply, and perpetuating all irrigation-project sumps for the needs of wild fowl. The Reclamation Service has indicated a growing interest in this type of conservation cooperation, and will now actively assist the Biological Survey in achieving these ends.

#### FIRST YEAR'S ACCOMPLISHMENTS

The end of the fiscal year registered the accomplishment of restoration projects on 19 major refuges and 13 secondary areas and nesting grounds. Among the outstanding projects, some of which are already functioning as restored nesting areas and refuges, are Lake Malheur and the Blitzen River, in southern Oregon; Lake Mattamuskeet, in North Carolina; the Mouse River section of North Dakota; Valentine Lakes, in Nebraska; and the Medicine and Bowdoin Lakes, in Montana. The States of South Dakota, Minnesota, Michigan, Wisconsin, Illinois, Missouri, Arkansas, and California have each their quota of greater or lesser projects, according to the availability of immediately restorable waterfowl areas; and no major flyway of the migratory birds was neglected in negotiating purchases of areas conspicuously contributing to the restoration program. Numerous refuges previously purchased but neglected for want of funds were put into the program, and rehabilitation was accomplished under the emergency employment provisions.

In the course of the year, the field work of eight waterfowl biologists was directed in surveys to determine the suitability of various habitat sites for waterfowl-restoration purposes. These men, working in every State in the Union, inspected and studied 720 tracts, aggregating 8,251,670 acres. The average size of the tracts inspected was 10,716 acres. This gigantic task was necessary not only for the institution and successful prosecution of the year's work, but also as a preliminary step toward the continuing program for the next 2 years, which was made possible by the special appropriation for this purpose in June 1935.

Inasmuch as funds for the acquisition of refuges were not made available until early in July, and because the \$2,500,000 construction money would revert to the Treasury after March 31, 1935, land acquisition had to be pushed at a pace that was perhaps too rapid for the most economical operations. Despite this handicap and the great dearth of available trained land examiners and negotiators, 653,000 acres of waterfowl-refuge land were optioned and approved by the Secretary in sufficient time to permit the solicitation prior to March 31 of engineering bids for necessary water impoundment; the letting of contracts totaling \$892,181.55 (listed in table 2); and the planning and soliciting of bids for headquarters and administrative developments on the respective refuges, aggregating \$440,280 (table 3). Details of headquarters contracts let for 16 refuges and of plans and specifications completed for 10 others are shown in tables 3 and 4.

TABLE 2.—*Water-impoundment contracts let on 653,000 acres of waterfowl refuges prior to Mar. 31, 1935, under allotments expiring on that date, and the amount for each*

Refuge	Amount	Refuge	Amount
Illinois, Chautauqua Bottoms.....	\$78,000.00	North Dakota—Continued.	
Michigan, Seney Marsh.....	70,574.30	Lower Souris.....	\$146,318.30
Missouri, Squaw Creek.....	48,338.00	Upper Souris.....	239,768.14
Montana, Medicine Lake.....	54,620.25	South Dakota:	
North Dakota:		Lacreek.....	116,527.86
Arrow-wood.....	25,600.50	Sand Lake.....	41,984.00
Des Lacs.....	70,450.20	Total.....	892,181.55

TABLE 3.—*Details of contracts let for headquarters and administrative developments on 16 waterfowl refuges*

Refuge	Contract amount	Material and sub-contract (60 per cent)	Labor				
			Amount (40 per cent)	Skilled (40 percent)		Unskilled (60 percent)	
				Hours	Rate	Hours	Rate
Michigan, Seney Marshes.....	\$24,000	\$14,000	\$10,000	5,714	\$0.70	15,000	\$0.40
Missouri, Squaw Creek.....	11,775	7,000	4,775	2,547	.75	6,366	.45
Montana, Medicine Lake.....	34,972	20,472	14,500	8,286	.70	21,750	.40
North Dakota:							
Arrow-wood.....	34,484	20,484	14,000	8,000	.70	21,000	.40
Des Lacs.....	30,783	18,283	12,500	7,143	.70	18,750	.40
Lostwood Lake.....	12,476	7,000	5,476	3,129	.70	8,214	.40
Lower Souris.....	34,620	20,620	14,000	8,000	.70	21,000	.40
Upper Souris.....	16,217	9,716	6,500	3,714	.70	9,750	.40
South Carolina:							
Cape Romain.....	21,792	12,792	9,000	6,000	.60	21,600	.25
Savannah River.....	27,473	16,000	11,473	7,648	.60	27,535	.25
South Dakota:							
Lacreek.....	28,190	16,690	11,500	6,571	.70	17,250	.40
Sand Lake.....	33,362	19,862	13,500	7,714	.70	20,250	.40
Waubay.....	14,770	8,770	6,000	3,429	.70	9,000	.40
Tennessee, Lake Isom.....	11,475	7,000	4,475	2,754	.65	7,671	.35
Utah, Bear River.....	60,275	35,000	25,275	13,480	.75	33,700	.45
Wisconsin, Trempealeau.....	29,433	17,433	12,000	6,857	.70	16,000	.45
Contract expansions for outside services (telephone, sewer, water, etc.) for all the above refuges.....	14,183	8,510	5,673	3,242	.70	8,511	.40
Total.....	440,280	259,632	180,647	104,228	-----	283,347	-----

TABLE 4.—*Details of plans and specifications completed at the end of the year for proposals for headquarters developments on 10 waterfowl refuges, additional to contracts listed in table 3*

Refuge	Estimated cost	Material and sub-contract (60 per cent)	Labor				
			Amount (40 per cent) <sup>1</sup>	Skilled (40 percent)		Unskilled (60 percent)	
				Hours	Rate	Hours	Rate
Arkansas, White River.....	\$37,000	\$22,000	\$15,000	9,231	\$0.65	25,714	\$0.35
California, Sacramento.....	33,000	19,500	13,500	7,714	.70	20,250	.40
Illinois, Chautauqua Bottoms.....	18,000	10,500	7,500	4,000	.75	10,000	.45
Michigan, St. Clair Flats.....	15,000	9,000	6,000	3,200	.75	8,000	.45
Minnesota:							
Mud Lake.....	39,000	23,300	15,700	8,373	.75	20,933	.45
Winona (warehouse).....	20,000	12,000	8,000	4,571	.70	10,666	.40
Nebraska, Valentine Lakes.....	40,000	24,000	16,000	8,000	.70	24,000	.40
North Carolina, Lake Mattamuskeet.....	100,000	60,000	40,000	24,615	.65	80,000	.30
North Dakota, Kenmare (warehouse).....	20,000	12,000	8,000	4,571	.70	10,666	.40
Oregon, Lake Malheur.....	40,000	24,000	16,000	8,666	.75	21,333	.45
Water-supply systems, various refuge headquarters.....	15,000	10,000	5,000	2,857	.70	7,500	.40
Administrative expense.....	18,000						
Total.....	395,000	226,300	150,700	85,798		239,062	

<sup>1</sup> Estimated expenditure per man-year of employment, \$1,812.50.

The land required in the institution of this program was examined, appraised, and negotiated for by the Division of Land Acquisition, whose record is elsewhere detailed in this report.



TABLE 5.—*List of migratory-waterfowl refuges consummated during the fiscal year 1935, comprising 31 new refuges obtained with emergency funds, 1 obtained with migratory-bird hunting-stamp funds, and 10 existing refuges rehabilitated*

## UNDER EMERGENCY FUNDS

State and refuge	Acreage		Important features
	Planned	Optioned <sup>1</sup>	
Arkansas, White River.	110,000	107,968.18	A super refuge protecting one of the greatest winter concentration areas of mallards in the United States.
California, Sacramento.	10,880	10,880.00	Great goose wintering area, necessary to save 3 species from extinction.
Illinois, Chautauqua Bottoms.	5,000	4,786.37	A much-needed migration sanctuary in the heart of the Illinois ducking country.
Louisiana:			
Delta.....	37,000	36,860.97	A great wintering refuge of increasing importance.
Lacassine.....	30,000	29,814.00	Important unspoiled marsh area for wintering ducks.
Sabine Lake.....	137,233	137,233.00	Largest tract of unspoiled coastal marsh left available to migratory waterfowl in the United States.
Michigan:			
Lake St. Clair.....	14,000	14,000.00	An important cooperative undertaking with the Michigan Conservation Department, in an area of heavy migrational concentration.
Sentry Marshes.....	24,630	19,361.62	Restoration of an important black-mallard producing area.
Minnesota:			
Mud Lake.....	53,000	52,713.00	Restoring an unwise drainage project to a valuable nesting area.
Rice Lake.....	10,600	10,580.00	Important for nesting facilities, and a valuable flyway resting area.
Missouri:			
Squaw Creek.....	7,000	6,980.74	Strategic resting point on Missouri River migration route.
Swan Lake.....	10,000	8,196.26	Important Missouri resting area on Grand River migration route.
Montana:			
Lake Bowdoin.....	<sup>2</sup> 640	640.00	Most important waterfowl resting lake and attendant breeding ground in Montana.
Medicine Lake.....	23,700	21,528.00	A superior nesting area in eastern Montana.
Red Rock Lakes.....	25,000	20,860.00	An excellent duck-nesting area and one of the few remaining nesting places of the trumpeter swan in the United States.
Nebraska, Valentine Lakes.	68,910	67,747.21	A super refuge—the choicest of the sandhill nesting areas.
North Carolina, Lake Mattamuskeet.	50,000	50,000.00	The most important goose and swan wintering area on the Atlantic coast.
North Dakota:			
Arrow-wood.....	14,000	13,436.68	A nesting-refuge restoration; an extensive public demonstration area.
Des Laes.....	15,000	14,059.71	A great nesting and resting place, especially for diving ducks; Northwest field laboratory here.
Lostwood.....	30,000	23,826.85	A large section of morainal pothole country with almost a dozen permanent lakes and 10,000 nesting potholes.
Lower Souris.....	50,000	47,026.71	A super refuge—the greatest nesting restoration; planned eventually to produce 1,000,000 ducks annually.
Upper Souris.....	34,000	29,676.78	Storage dam for both Upper and Lower Souris projects; important flood-control structure and considerable nesting.
Oregon, Lake Malheur and Blitzen Valley.	64,720	64,720.00	A super refuge; restoration of greatest waterfowl area on the Pacific coast.
South Dakota:			
Lacreek.....	9,362	9,362.06	One of the finest of the nesting-restoration projects.
Lake Andes.....	365	347.53	An important resting pond in a heavily overshot area.
Sand Lake.....	20,000	20,303.50	Large-scale nesting-restoration project.
Waubay.....	2,645	2,117.08	A superior diving-duck nesting area.
Tennessee, Lake Isom.	4,200	907.00	Important resting unit adjacent to the Reelfoot Lake concentration area.
Texas, Muleshoe Lakes.	5,978	5,811.00	Important sanctuary for great winter concentrations of shoal-water ducks.
Washington, Turnbull.	4,500	2,412.00	Excellent pothole nesting area.
Wisconsin, Trempealeau.	6,112	6,112.00	An extensive public-demonstration waterfowl area.
Total, from emergency funds...	878,475	840,268.25	

UNDER FEDERAL MIGRATORY-BIRD HUNTING-STAMP FUNDS <sup>3</sup>

Minnesota, Talcot Lake.	1,029	1,029.00	Nesting and resting refuge; cooperation with Minnesota Conservation Department.
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<sup>1</sup> Including acreage committed and title being cleared to the United States.

<sup>2</sup> Remainder public domain, transferred by Reclamation Service.

<sup>3</sup> Stamp funds not available until late in the year.

TABLE 5.—*List of migratory-waterfowl refuges consummated during the fiscal year 1935, comprising 31 new refuges obtained with emergency funds, 1 obtained with migratory-bird hunting-stamp funds, and 10 existing refuges rehabilitated—Continued*

## EXISTING REFUGES REHABILITATED

State and refuge	Acreage		Important features
	Planned	Optioned	
Arkansas, Big Lake.....	12, 000	10, 108. 00	Water stabilization and willow clearing (\$4,999.95). Purchase of extensive food areas.
Florida, St. Marks.....	5, 000	4, 897. 00	Increasing and rounding out acreage; extensive headquarters and fresh-water development. Securing release of agricultural rights (\$3,100).
Georgia, Savannah River.....	9, 300	4, 152. 00	Additional water and nesting resources for an already valuable refuge.
Maryland, Blackwater.....	3, 400	3, 383. 11	A waterfowl addition to a big-game refuge. Funds for additional wells and fencing (\$4,242.42).
Nebraska, Crescent Lake.....	7, 700	4, 993. 00	Rounding out boundaries and purchase of Bull Island to afford fresh water and food.
Niobrara Refuge.....	5, 000	2, 616. 00	Increasing and rounding out acreage; extensive headquarters and fresh-water development.
Nevada, Railroad Valley.....			Extensive headquarters development and reorganization; proposed wild-fowl research center (\$70,760).
South Carolina, Cape Romain.....			
Savannah River....			
Utah, Bear River.....			
Total.....	42, 400	30, 149. 11	

A total of \$251,010.93 was spent for gross equipment. This comprised patrol and work boats; headquarters wells and wells for Civilian Conservation Corps camps; water gages; draglines, shovels, scrapers, road rippers, and graders for water-impoundment and embankment work; rock crushers and trail builders for roads and patrol trails; barbed wire for stock-proof fences; levels and transits for survey work; trucks and pick-ups for refuge transportation and development; 100-foot patrol towers; redesigned refuge markers (10-year enamel shields); assorted tools for minor refuge development; tractors, disks, seeders, and mowers for supplementary waterfowl-food raising; fire-fighting equipment; and numerous other instruments and tools indispensable in the development and maintenance of migratory-waterfowl refuges.

## INITIAL REFUGE DEVELOPMENT

It should be pointed out that the Bureau cannot assume immediate development of the refuge areas acquired during the year, as it takes from 6 months to a year to complete the transfer of title to the United States, and formal Executive order for the establishment of each refuge is made thereafter. On a number of prospective refuges, however, where reconditioning for waterfowl is most urgent, development has been undertaken through the medium of a license obtained from the individual landowners, giving the Bureau the right to early occupancy and development of the land. Where this has been possible, an extensive development program is already under way, involving further impoundment of water, erection of nesting islands, food plantings, reforestation, reduction and control of fire hazards, building of patrol roads and lanes, erection of patrol towers and stock-proof fencing, control of predators, water-table investigations, sinking of artesian wells, flood irrigation, and many other rehabilitation activities. On one of the refuges thus rehabilitated, more than 500 pairs of nesting birds were counted on 2,000 acres of land in the current breeding season. Complete topographic surveys have been made on most of the refuges in order to expedite future development.

On June 30 there were 22 Civilian Conservation Corps camps at work on migratory-waterfowl projects. This type of development is being rapidly expanded, and application has been made for a \$5,500,000 allotment of National Emergency Council funds, which, if granted, will lead to the complete physical and biological rehabilitation of all migratory-bird refuges.



The waterfowl-restoration program is concomitant with a fur-resources restoration, which also is of vital importance. With the exception of the areas saved by the Biological Survey, the entire muskrat population of South Dakota, for example, has been wiped out. From the preserved reservoirs of breeding stock, the State fish and game commission plans to take all excess animals and repopulate thousands of lakes and sloughs, which will be restored during the next wet cycle.

### WILDLIFE REFUGE ADMINISTRATION

The Biological Survey is now administering 99 priorly established bird refuges, exclusive of 6 big-game preserves on which birds also are protected. These areas aggregate 1,627,409 acres, exclusive of extensive chains of island refuges in Alaska and Hawaii. Of this area in the United States proper, 767,298 acres are primarily suitable for waterfowl; the remainder, including the various bird rocks, rookeries, and nesting islands in the interior lake regions and along the seacoasts, are principally suitable for nongame birds. Work of the past year in waterfowl restoration will add 32 refuges (table 5), totaling 841,297 acres, to the list of those that are primarily suitable for waterfowl, but will be of service equally well to other species of native local game and other birds. With measures completed for the establishment of 32 additional wildlife refuges during the year, the number now supervised by the Bureau of Biological Survey or in process of establishment is 137.

Much-needed administrative authority and control over the disposition of surplus animals and other products of wildlife refuges was lodged in the Secretary of Agriculture by an act approved June 15, 1935 (Public, No. 148—74th Cong.), which also authorized the distribution of 25 percent of the receipts from such refuges for the benefit of public schools and roads in the county or counties in which located. This provision will afford material relief to local authorities who would suffer loss of revenue by the inclusion of taxable lands in wildlife refuges under the Federal migratory-waterfowl restoration program.

#### BIRD REFUGES

##### MALHEUR MIGRATORY WATERFOWL REFUGE

The acquisition of a 64,717-acre tract known as the famous "P Ranch", Harney County, Oreg., an area of historic interest in connection with the early settlement of the section, was completed in March, to be combined with the Lake Malheur Bird Refuge, which adjoins it on the north. The combined areas will be known as the "Malheur Migratory Waterfowl Refuge." In October 1934 opening the gates on the Blitzen River released practically all available stored water, immediately flooding a considerable area within the dry Malheur Lake bed and by the middle of April spreading over 15 sections of it. Late in the spring of 1934 the lake had become dry, the only water entering it coming from one large spring. Because of the extreme drought of last year no waterfowl were on Malheur Lake proper, though a goodly number of ducks and Canada geese were hatched and raised in Blitzen Valley in the general vicinity of the refuge. The partial flooding of Lake Malheur during October attracted myriads of white-fronted, snow, and Canada geese, which fed in the stubble fields and in the shallow water of the lake until it froze over in December. A considerable number of Canada geese and a lesser number of mallards wintered in the open water in favored localities in the valley. In March there was a great migration of snow geese and pintail ducks, but no marked influx of other ducks.

The south side of Malheur Lake was unusually favorable for nesting this year on account of the growth of rank grass and other cover, due to restoration of some water from the Blitzen River and to greater precipitation than at any period in the past 7 years. A large number of Canada geese successfully raised broods there. Twenty-four young geese, hatched at the refuge under domestic hens, were shipped to the Upper Mississippi River Refuge, at Winona, Minn. Owing to inadequate rainfall in the mountains to the north, no water reached Lake Malheur through the channel of Silvies River and no cover or feed for waterfowl was afforded this year on the entire north shore of the lake. Although there was a fair representation of all the species of ducks on the refuge, their numbers were far below those of a few years ago.

Sage hens nested in the vicinity this year, and it is apparent that this species has increased there during the past 3 or 4 years. A considerable number of

mule deer also are living along the Blitzen River within the refuge, and antelope from high plateau lands adjacent to Blitzen Valley come and go at will across the refuge, small bands of from 5 to 15 not being an uncommon sight.

A Civilian Conservation Corps camp established on this area is carrying on a large development program. Work accomplished included the construction of several miles of dyke, a new road, and a site for a look-out tower.

Many visitors come to this refuge to see and study birds and other kinds of wildlife. During the fall, winter, and early spring, 1,597 ducks and coots were banded at the banding trap at the big spring adjacent to the refuge.

The case of the *United States v. The State of Oregon*, to determine ownership of lands in the lake bed and vicinity, was decided in favor of the Federal Government in April, and this decision removes many of the obstacles that have prevented necessary control and satisfactory development of the area for waterfowl.

#### BIG LAKE BIRD REFUGE

High-water conditions on the Big Lake Bird Refuge in Arkansas during the spring were detrimental to the nesting of the wood duck and the hooded merganser, the only species that breed there. A decrease was noted in the numbers of both species this year, and high water was responsible for the presence of egrets and herons also in comparatively small numbers. A goodly number of ducks, however, used the refuge on their southern and northern flights, and during January, February, and March, 7,000 to 8,000 were feeding and resting there, but as high water made feeding conditions unfavorable, many of the birds moved elsewhere.

Under National Industrial Recovery Administration allotments there were completed a new headquarters building, a good motorboat hull, and a 100-foot observation tower. Some 900 acres of small willows were cut away, and many other improvements were effected for water control.

#### BLACKBEARD ISLAND WILDLIFE REFUGE

An increase in land birds has been noted on the Blackbeard Island Wildlife Refuge in Georgia but during the past three seasons there has been a marked decrease in waterfowl. Pelicans and cormorants also have decreased, but there has been an increase in chachalacas (an introduced tropical bird). Improvement projects necessitating the presence of workmen may have driven some of the birds away, and these activities may also have affected the deer, a number of which have crossed to the adjacent Sapelo Island. Blackbeard Island has plenty of food for wildlife, and most of the deer observed are in the very best of condition. Approximately 700 wapato plants have been set out for duck food.

Extensive improvements under National Industrial Recovery Administration allotments include a 4-foot trail from one end of the island to the other, erection of a steel observation tower, establishment of telephone connection with the mainland, drilling of 4 wells, from which 3 fresh-water ponds have been produced, and creating another pond from a well at the north end of the island. All the old buildings have been wrecked, and material for a new headquarters has been purchased.

#### TULE LAKE, CLEAR LAKE, AND UPPER KLAMATH BIRD REFUGES

The Tule and Clear Lakes Refuges in California and the Upper Klamath Bird Refuge in Oregon are administered as a unit. Large numbers of geese and ducks were observed during the migration flights, and many nested on the areas, most of them on Tule Lake. At one time, late in February, 50,000 ducks were seen in flight at Tule Lake, most of them pintails, and there were also goodly numbers of geese. In March, 22,000 lesser snow geese, 10,000 white-fronted, 6,000 cackling, and 2,000 Canada geese were noted in the vicinity of Tule Lake Refuge, also about 30,000 ducks, mostly mallards and pintails. By May 1 all ducks and geese not nesting or crippled left this refuge on their northern flight.

During the fall and winter months, California quail, ring-necked pheasants, and white-crowned sparrows were fed on Tule Lake and vicinity, about 1,000 pounds of wheat having been donated by ranchers for the pheasants. Winter migration flights noted at Upper Klamath Lake included various species of ducks, coots, and swans. A few sick ducks were picked up at this refuge in April.



More than 2,000 muskrats were taken in the Tule Lake Refuge during the fall and spring, indicating the extent to which these animals have increased since the first were seen there in 1931.

In May it was estimated that there were 6,000 birds in the pelican colony at Clear Lake. Six hundred visitors registered at Tule Lake during the year. Predatory animals and birds are numerous on these three refuges so that control measures will have to be undertaken.

#### BLACKWATER MIGRATORY BIRD REFUGE

Maintenance of a Civilian Conservation Corps camp on the Blackwater Migratory Bird Refuge in Maryland during the greater part of the year somewhat subordinated the regular work to that of the camp program. Artificial feeding of the birds, however, was carried on for about 2½ months when weather conditions permitted. During the spring 45 acres were planted to corn, 30 acres in feed patches to millet, cowpeas, hemp, and lespedeza, and about 10 acres of ponds to sago pondweed and other grasses.

It is estimated that the mallards that nested on the refuge reared 80 to 100 young. An attempt was made to raise young ducks artificially from the eggs of the mallards that frequent the headquarters, the eggs being gathered and set in an incubator. From the 500 eggs thus used only 120 ducks were hatched, the rest proving infertile. The weather was unfavorable, and only 20 ducks were raised.

Improvement work consisted of the construction of truck trails, removal of fire hazards in timberlands, making firebreaks along the boundary lines, and erection of about 5 miles of fence along roads and boundaries to exclude roaming stock and protect planted areas.

#### CAPE ROMAIN MIGRATORY BIRD REFUGE

The Cape Romain Migratory Bird Refuge, an area of 54,061 acres of land and water on the coast of South Carolina, consisting of vast marshes, innumerable winding creeks, oyster banks, and ocean beaches, is frequented by multitudes of birds, 210 species having been noted thereon, and as many as 90 species in a day. It is attractive as a nesting area for oyster catchers, herons, and egrets, and, since its establishment, for brown pelicans. Probably 2 or 3 times as many pelicans have been noted as in previous years, and the crop of young birds is correspondingly increased. The pelicans heretofore have deposited their eggs on low sandy beaches where they were washed away by storms and high tides, but this year they nested on high sand dunes about 100 yards back from their former nesting ground.

More than 500 nests of herons have been seen on one small island, great colonies of royal and least terns lay their eggs among the sands, black skimmers nest on this refuge, marbled godwits are occasional visitors, and it is the northernmost Atlantic-coast wintering ground of the long-billed curlew. Laughing gulls nest in considerable numbers, and the wood ibis spends May and June on the refuge. Many hundreds of willets nest in grass on barrier reefs, and clapper rails are plentiful. Ducks, however, as generally throughout the country, were few in numbers this year. Various insectivorous birds also frequent this area.

Great numbers of loggerhead or giant sea turtles inhabit the small creeks and bays during the summer months and use the barrier beaches as nesting areas: other varieties of turtles may be seen, including the diamondback terrapin.

Under allotments of the National Recovery Administration and other emergency funds, headquarters buildings are under construction and other improvements have been made, consisting of a patrol boat, a boathouse and wharf, a marine railway, and a 100-foot observation tower. A 50-foot observation tower has been built in the northeastern part of the refuge, from which the two great duck-concentration areas can be kept under surveillance. An additional tower will be erected in the southwestern section.

The refuge is coming to be widely known among bird lovers, bird-conservation organizations, and naturalists as a concentration point for birds, and as a result many visitors come to see the nesting colonies and for scientific study, every effort being made by the refuge employees to assist them in their observations.

## CRESCENT LAKE MIGRATORY BIRD REFUGE

The height of the spring migration at the Crescent Lake Migratory Bird Refuge in Nebraska was reached in the latter part of March, and an estimate indicated approximately 30,000 ducks there, shovelers predominating. Large numbers of snow geese stopped during the spring migration, and approximately 2,000 white pelicans were on Island Lake until early in May. About 8,000 ducks and coots, 200 white pelicans, and 450 western grebes remained during the summer. Ring-necked pheasants were fed there during the winter.

Antelope are seen frequently about the refuge and some occasionally come within its boundaries. Employment of a hunter during the winter and until early in April resulted in the elimination of coyotes from the refuge and its environs, approximately 275 of the animals having been taken.

Improvements under National Recovery Administration allotments included completion of a fence around Gimlet Lake, for stocking it with Canada geese, the birds to be donated by a resident of Nebraska; construction of dams, fireguards, fences, and approximately 2 miles of graded road; and boring of two flowing wells.

## ST. MARKS MIGRATORY BIRD REFUGE

The most prominent winter visitant at the St. Marks Migratory Bird Refuge in Florida is the Canada goose, approximately 5,000 of which rested at the refuge during the season. This is a large increase over preceding years and is attributed to thorough protection and abundance of natural food. The burning over of certain areas of marsh during the latter part of January was followed by the sprouting of an abundance of young, tender shoots, which were of great assistance in providing the geese with food late in winter and early in spring. Ducks of various species frequented the refuge in goodly numbers, and many species of shore, marsh, upland-game, and insectivorous birds find a haven on the area. Nesting birds include clapper rails, eastern willets, Wilson's plover, quail, doves, turkeys, and various insectivorous species. Alligators and turtles are also numerous.

Considerable improvement work was done during the year around the headquarters, a cabin was built for the use of patrolmen, fire lanes were constructed, and part of the boundary line was cleared and marked.

## SWANQUARTER MIGRATORY BIRD REFUGE

On the Swanquarter Migratory Bird Refuge in North Carolina many improvements have been effected with the aid of the Civilian Conservation Corps camp stationed there for the past 2 years. These include the construction of 11½ miles of fire lanes, about 5 miles of it 30 feet wide, 3 miles of foot trails, a boathouse, pumphouse, and garage at headquarters, 1,350 feet of sea wall to prevent washing of the shore line, and 2 look-out towers. In addition, improvements were made around headquarters; much road work was done, including graveling, sodding, and cleaning; the entire refuge was posted; considerable ditching, staking, and spraying were undertaken for mosquito control; and there was a general clean-up of 40 acres for fire prevention.

Wild fowl increased at Swanquarter about 20 percent over the previous year, probably owing in part to the reduced food in Mattamuskeet Lake, which occasioned the passage of the birds back and forth from one refuge to the other. A 50-percent increase has been noted in quail on this refuge, and the same percentage of increase has been observed in deer, bears, and squirrels.

## MATTAMUSKEET MIGRATORY WATERFOWL REFUGE

Mattamuskeet Lake, Hyde County, N. C., purchased under emergency funds, was established as a migratory waterfowl refuge by Executive order of December 10, 1934. It consists of approximately 50,000 acres of land and water being restored as part of the waterfowl program. Swans, geese, and many species of ducks—principally pintails, widgeons, mallards, and black ducks—are found in numbers on the water areas. It is expected that the lake, which is being permitted to restore itself naturally, will again attract large concentrations of waterfowl. During the winter a number of crippled ducks and geese were picked up on the lake and placed in a pen for banding and release when fully recovered.

Improvement work undertaken with the aid of the nearby Swanquarter Civilian Conservation Corps camp, consisted of cutting 15 miles of boundary



trail, seeding 120 acres to corn, soybeans, and rice, and transplanting 5,000 wild celery and sago pondweed plants. Some unneeded buildings were razed, 2 garages were partially completed, and 5 structures were moved to higher ground. Considerable work was done on a hydrographic survey for increasing the wild-fowl food in the lake.

Two areas of 5,000 acres each were set aside for hunting and administration in cooperation with the State Department of Conservation. Birds taken included 1,860 geese and 625 ducks.

#### UPPER MISSISSIPPI RIVER WILDLIFE REFUGE

The drought and low-water conditions that prevailed on the Upper Mississippi River Wildlife and Fish Refuge throughout most of the year 1934 continued until the middle of August, when the river reached its lowest stage in 70 years, river stages being first recorded in 1864. Early in the fall, however, just prior to the opening of the hunting season, a generous rainfall raised the river sufficiently to bring water into lakes and marshes that had long been dry. As a consequence, conditions attractive for waterfowl prevailed generally throughout the refuge during the hunting season, and in certain sections the concentrations were noteworthy. The most outstanding concentration, and one that continued for several weeks, was in the so-called "Winnieshiek Bottoms", in Wisconsin. Old residents stated that more ducks came to that area than for many years. On the whole, waterfowl conditions on the refuge were more favorable than during any fall within recent years, the mallard being the predominating species.

During the winter, the watershed of the upper Mississippi River received a heavier snowfall than in many years. As a result during the spring the river within the refuge reached its highest stage since 1922, overflowing cornfields, bottom-land meadows, and wooded sections, and considerable numbers of waterfowl were attracted to these areas on their northern migration. So scattered were they, however, that it was difficult to make anything like an accurate estimate of their numbers, but the consensus of experienced observers was that although present in considerable numbers the birds were perhaps 25 percent less numerous than in the preceding spring.

The drought conditions that had previously prevailed contributed largely to a reduction in the population of muskrats, the chief fur resource of the refuge, and no public trapping of fur animals was permitted during the year.

There were practically no fires of any consequence, compared with the prolonged and destructive ones that occurred last year. The improvement was due to high-water conditions during fall and spring and to the fact that the ground was covered with snow throughout the entire winter.

The heavy blanket of snow from November until late in March raised a greater problem than in any year since the establishment of the refuge in caring for pheasants, quail, prairie chickens, and other upland birds. It was necessary to equip rangers with snowshoes to enable them to reach the feeding stations for replenishing supplies. Under conditions thus prevailing, the upland birds, including not only those resident within the refuge but in surrounding areas, were almost completely dependent for existence during the winter months upon the artificial feeding stations thus maintained. About the same number of upland game birds was noted as during the preceding year, the maintenance of their numbers being due to the artificial feeding operations during the winter and protection against hunting and fires.

Where arrangements could be made for having grain planted and cared for, many patches, principally corn and wheatland milo, were planted on suitable land throughout the refuge.

The 9-foot channel of the upper Mississippi River, long contemplated and under various stages of construction during the past 2 or 3 years, has now become a reality in certain areas of the refuge. The Alma and Whitman pools, inundating thousands of acres of bottom land between Winona and Wabasha, Minn., were filled about June 1 and thus for the first time afforded opportunity to observe water levels and the actual extent of inundation. The results of such partial flooding and of maintenance throughout the year of stabilized levels in the pool areas will be watched to note the effect on wildlife and wildlife environment.

The policy of issuing free permits to needy persons to gather fuel for domestic use was continued. Permittees were authorized to cut wood from areas certain to be flooded by the 9-foot channel. No grazing permits were issued, as

the emergency of the previous year that impelled farmers to graze their suffering livestock on the refuge no longer existed. The conditions that led to the livestock grazing last year were responsible also for an unprecedented demand for the privilege of cutting hay on the refuge meadows. A nominal charge per ton was made, and it was further required that all mowers be equipped with a flushing device to insure the protection of ground-nesting birds ahead of the mower. Other precautionary measures were taken to insure against interference with wildlife.

#### BEAR RIVER MIGRATORY BIRD REFUGE

In comparison with the supply of waterfowl over the country as a whole, the concentration of birds at the Bear River Migratory Bird Refuge, Utah, has been encouraging. With the exception of certain species that are apparently becoming scarce, the refuge continues to attract a great variety of birds in large numbers. The concentration has not been so great, however, as in previous years, and this indicates a decrease in the general supply. The most notable shortage was among redhead ducks, and, to a lesser extent among cinnamon teal. Though the total number of waterfowl visiting the refuge shows a decrease, greater numbers are without question breeding there.

The past winter was so unusually mild that, with most of the flooded area free of ice, except for a few days, the birds had access to food, and many remained throughout most of the winter, though during a rather heavy freeze, for about 10 days, the number there was temporarily reduced about 80 percent. Between 5,000 and 6,000 whistling swans remained on the refuge until April. This is the second successive winter that large flocks of swans did not migrate farther south; furthermore, they now winter on the refuge proper, whereas until 2 years ago most of them stayed on adjoining areas.

Though the snowfall on the lowlands was exceptionally light, a heavy fall in many of the mountain drainage areas increased the spring stream flows materially, and this, coupled with numerous heavy spring rains, produced an ample spring run-off and made the prospects favorable for maintained water during the summer. The wet spring and adequate water in Bear River produced a rank and luxuriant growth of vegetation. Never in the 5 years since the refuge project was completed has there been such a bountiful supply of duck food. Some experimental plantings were made of various grains.

Since the serious outbreak of botulism, or western duck sickness, in 1932, there has been a constant decrease in mortality and the number of birds afflicted. Not more than half a dozen birds appeared to be afflicted last spring, and not a single one was found that had died from the disease.

A total of 1,044 ducks and coots were banded at this refuge during the year. It is worthy of note that the number of redheads banded in each of the past 6 years has constantly decreased—from 1,010 in 1929 to 54 in 1934.

Nesting conditions were favorable, though breeding began late, and many of the ducks were still incubating at the end of the year. More birds nested on the refuge than at any previous time since its completion, and a high percentage of hatch is indicated with but little mortality among the young. In an effort to improve the nesting conditions, 7 artificial islands were constructed in the interior of the various units, in addition to 1 previously constructed. These eight nesting havens are proving particularly attractive to shore birds.

Seven nests of the Caspian tern were found on the division dike between units 3 and 4, establishing a new nesting record for the refuge. A small colony of these terns has nested on an island in Utah Lake, 100 miles to the south, but this is the first nesting record north of that point in Utah.

An extensive nesting survey was undertaken last spring, and upon its completion much valuable information will have been obtained on numbers of breeding birds and eggs, and percentage of hatch.

During the fall hunting season 2,298 hunters took 7,559 waterfowl on areas within the refuge boundaries open to shooting.

Improvements under National Recovery Administration allotments were continued and have been largely completed. Emergency refuge-development funds provided for construction of artificial nesting islands, which were completed to the extent the allotment permitted. Work finished under National Recovery Administration funds included an administration building, a tool house, and 17 miles of telephone line, and much was accomplished in water control and road repairs. The work of a Civilian Conservation Corps camp, established on this



area for the fourth and fifth periods, included stream and lake-bank protection under which 902,000 square yards of lake shore along the dike line were protected against erosion and wave action, completion of 6 miles of stock fence and 10 miles of telephone line, building of a vehicle bridge, erection of a 100-foot observation tower, and installation of a water-control structure in a canal.

### BIG-GAME PRESERVES

Shortage of feed occasioned by drought necessitated the feeding of buffalo and other big-game animals on all the fenced preserves during the winter of 1934-35. An acute feed situation also developed at the Elk Refuge in Wyoming in connection with a heavy concentration of elk on the feeding grounds during the long winter. Curtailment of numbers in all restricted herds was accomplished through surplus disposal. As in previous years, most of these animals were donated for use as food by Indians on nearby agencies. In some instances, however, live animals were transferred for stocking enclosures constructed on some of the Indian reservations. Exclusive of 1,177 big-game animals on the Wichita Mountains Wildlife Refuge, Okla., the number of big-game animals on fenced enclosures maintained by the Biological Survey at the close of the year was 1,198, which is a decrease of 360 animals on these four refuges since 1934, due to disposals because of feed shortage (table 6).

TABLE 6.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey*<sup>1</sup>

Preserve	Buf-falo	Elk	Ante-lope	Moun-tain sheep	Deer		Total <sup>2</sup>	Young born in calendar year 1934 <sup>3</sup>		
					White-tailed	Mule		Buf-falo	Ante-lope	Moun-tain sheep
National Bison Range, Mont.	441	103	-----	53	4 28	4 47	672	117	-----	8
Wind Cave Game Preserve, S. Dak. <sup>4</sup>	180	4 65	4 39	-----	2	4 30	316	51	12	-----
Niobrara Game Preserve, Nebr.	134	38	12	-----	5	1	190	33	2	-----
Sullys Hill Game Preserve, N. Dak.	17	4 20	-----	-----	14	-----	51	7	-----	-----
Wichita Mountains Wildlife Refuge, Okla. <sup>5</sup>	327	4 245	-----	-----	4 605	-----	1,177	72	-----	-----
Total.....	1,099	4 471	4 51	53	4 654	4 78	2,406	280	14	8

<sup>1</sup> With the exception of those of young born, figures are for June 30, 1935.

<sup>2</sup> Including estimates.

<sup>3</sup> Young of elk and deer omitted, as in most cases estimates only could be made; but during the calendar year approximately 145 elk calves and 42 fawns of mule deer and 108 of white-tailed deer were observed on the preserves.

<sup>4</sup> Estimated.

<sup>5</sup> Abolished under act of Congress of June 15, 1935, and the area and the big-game animals thereon transferred to the Department of the Interior for administration in connection with the Wind Cave National Park, effective July 1, 1935.

<sup>6</sup> Transferred by order of the Secretary of Agriculture from the Forest Service to the Biological Survey, effective Apr. 1, 1935.

### NATIONAL BISON RANGE

In a disastrous fire started by lightning at the National Bison Range in Montana early in the morning of August 11, high winds swept the flames across grass and timberland made highly inflammable by the long-prevailing drought. After burning over about 5,300 acres and threatening destruction of the herds of big-game animals on the range, it was brought under control the next day, through cooperation of Forest Service employees and local men, assisting the force at the Bison Range. No losses of animals resulted so far as known, but vegetation and timber were destroyed over a wide area. Forage on the range made a satisfactory growth during the spring, however, and there was little permanent injury to the grass roots on the burned-over area. Shortage of range feed as a result of the fire made it necessary, however, to corral the buffalo in spring and to feed them for 2 months that the grasses might get a good start before the animals were turned out to graze. Thirty-eight acres on the range have been planted to crested wheatgrass.

Surplus big-game animals disposed of during the year included 178 buffalo, 77 elk, and 51 mule deer, of which 152 buffalo, the 77 elk, and 14 deer were transferred to Indian agencies, most of them for use as meat, but 19 of the buffalo were furnished to the Crow Indian Agency, Mont., for breeding purposes. All animals on the range (table 6) are thriving, including the albino buffalo, now 2 years old, which continues to be a great attraction to visitors.

Chinese pheasants, Hungarian partridges, and blue and ruffed grouse are found on the range, the pheasants being especially numerous, and during the open season thousands of them flock to the refuge. These birds and also ducks and deer were fed during the extremely cold weather in January. Canada and snow geese were observed in about the usual numbers, and a few swans and canvasbacks were seen, though these ducks do not visit this section in large numbers at any time. All the common ducks were noted. To control the numerous coyotes on the range a trapper was employed during June. Beavers on Mission Creek are thriving.

A Civilian Conservation Corps camp established on the range during the last quarter of the fiscal year improved roads and trails and completed approximately  $4\frac{1}{2}$  miles of fireguards. In addition, under National Recovery Administration funds the headquarters buildings were repaired and new roads were built.

#### WIND CAVE GAME PRESERVE

The severe general drought throughout the West made forage for all game animals unduly short on the Wind Cave Game Preserve in South Dakota and many of the buffalo were in rather poor condition. Forage growth during the wet, cold spring of 1935 was excellent, and practically all the animals (table 6) are in fine shape. By the end of June the range was in better condition than for several years, and a heavy seed crop of practically all forage plants was assured.

Surplus animals disposed of included 98 buffalo and 3 elk. Of these, 82 buffalo were transferred to the Pine Ridge Indian Agency for use as meat and for stocking a new buffalo pasture. Ten antelope fawns were seen during the year, but there were unusually heavy losses during the winter, 29 having been found dead. These losses were partly due to the fact that drought caused an extreme shortage of feed and forced the antelope to graze in the same pasture with buffalo and elk. These latter animals have learned to eat hay provided for them, but the antelope had not been fed regularly and apparently ignored feed put out. About 70 tons of hay shipped from Niobrara Game Preserve, Nebr., served to prevent unduly heavy losses of all big game except the antelope. Coyotes also were thought to have been responsible for losses of antelope, and control operations were undertaken.

Under the act of June 15, 1935 (Public, 148, 74th Cong.), Wind Cave Game Preserve was abolished and the area and the big-game animals thereon transferred to the Department of the Interior for administration in connection with the Wind Cave National Park, effective July 1, 1935. During the period of travel ended last September there were 15,205 visitors to the preserve.

#### ELK REFUGE

The feeding of the elk last winter at the Elk Refuge in Jackson Hole, Wyo., began on January 1 and continued until April 20. About 9,700 elk consumed approximately 3,261 tons of hay, 202 tons of cottonseed cake, and 50 tons of corn, of which 660 tons of hay were harvested on the refuge in the summer of 1934 and 170 tons of cottonseed cake and the corn were furnished by the State game department. The long winter and the large number of elk concentrated on the refuge brought about an acute feed situation, which necessitated emergency purchases amounting to \$30,000. All feed reserves except 268 tons of cottonseed cake were exhausted, and an emergency item of \$25,000 pending in the deficiency bill at the end of the fiscal year has since been made available for the purchase of feed for the coming winter. The State game department established three feeding grounds south of the town of Jackson, where 1,200 to 1,600 elk consumed about 400 tons of hay and 280 tons of cottonseed cake.

About 700 elk died on and adjacent to the feeding grounds, of which approximately 90 percent were calves that had contracted calf diphtheria. In all, 3,806 elk were removed from the herd, including 3,246 killed by hunters, 300 by the State game department for relief purposes, and 260 wounded or killed



during the hunting season and not recovered. A census was taken during the latter part of March and early in April, the elk on the feeding grounds being counted from the ground, and those wintering in outlying districts from an airplane. This count showed a total of 22,035, an increase of 2,180 over the previous census taken in 1932.

Under an appropriation made by Congress in June for the acquisition of lands for wildlife-refuge purposes, it is contemplated that the winter-feeding problems associated with the maintenance of the elk will be reduced to the minimum by acquisition of much-needed adjacent lands.

Deer have greatly increased in Jackson Hole during the past 13 years, and it is estimated that there are now 500 in the section. Twelve of these animals stayed on the refuge during the spring. About the same number of migrating waterfowl visited the refuge as in previous seasons, and some mallards, teal, and gadwall nested there. Coyotes have increased in number.

#### SULLYS HILL GAME PRESERVE

In order to benefit the pastures, more than the usual number of big-game animals were disposed of as surplus from the Sullys Hill Game Preserve in North Dakota. These included 10 buffalo, 26 elk, and 1 white-tailed deer, of which 6 buffalo and 6 elk were transferred to the Fort Totten Indian School for use as meat. The white-tailed deer herd was increased by the donation of 2 by a resident of North Dakota. All animals on the preserve (table 6) are generally in good condition.

About the same number of waterfowl were in the vicinity of Sullys Hill as last year, but the number of young birds raised may show an increase. Song and insectivorous birds have been more abundant than for many years. Pheasants and partridges also are increasing, but grouse and prairie chickens have decreased. Many upland game birds were saved from starvation during the last half of the winter by feeding them at suitable places. About 90 bushels of mixed grain was used for this purpose.

Road and trail improvement has been accomplished, the bed of a small lake in the picnic grounds was deepened along the shore, and a steel-piling cut-off dam along the lower side of this lake was completed under National Recovery Administration allotments. Visitors to the preserve during the year numbered 15,118, with 2,908 cars.

#### NIOBRARA GAME PRESERVE

At the close of the year the buffalo, elk, antelope, and deer on the Niobrara Game Preserve in Nebraska were in excellent condition, the elk being in better shape than for a number of years. Surplus animals, consisting of 30 buffalo and 35 elk, were disposed of, including 9 buffalo and 24 elk for use as meat by Indians on the Rosebud Agency. Four fine buffalo bulls were received from Custer State Park, S. Dak., in exchange for a like number from the Niobrara herd, and 1 young white-tailed buck deer was donated by the city park at Fort Dodge, Iowa.

Coyotes, jack rabbits, and fur-bearing animals have been increasing to such an extent that steps must be taken to curb their abundance, but pocket gophers have been practically eliminated from the area.

Encouraged by the abundance of spring rainfall, more birds nested on the preserve than during the previous 3 years. A few mallard ducks that had congregated on the ponds kept open by spring water had to be fed to carry them through the winter. Some prairie chickens and grouse also were fed until April, and these with pheasants and quail nested on the preserve in about the usual numbers.

Grazing conditions were better than at any time since 1930, though in March the most severe dust storm ever experienced in the West reached this preserve, which is located in the midst of a drought-stricken area that, in addition, had been eaten bare by grasshoppers. The great clouds of dust covered buildings and vegetation with a coating of soil so deep that it appeared doubtful whether vegetation would grow, but in April a heavy rainfall began and produced a splendid growth of grass on the pasture and hay lands.

Numerous improvements were begun or completed during the year, including a garage and 2 storage buildings, a look-out tower in the north big-game pasture, 2 windmills, and several wells. The west arm of the preserve was entirely fenced with a barbed-wire stock fence, an additional holding pen

was constructed to include part of a pond that affords a watering place for any game animals retained there, about 19 miles of truck trails were built in the big-game pasture, the construction of 2 dams has been begun, exhibition pastures for the animals have been improved, islands on which shore birds later nested were built in various ponds, and approximately 100,000 trees were planted on a little more than 200 acres.

#### CHARLES SHELDON ANTELOPE REFUGE

Breaking almost a decade of drought conditions in northwestern Nevada, precipitation for the winter 1934-35 reached a total of 10.5 inches and on the Charles Sheldon Antelope Refuge averted a serious situation for the summer of 1935. Range grasses have been restored in amazing abundance, and the water tables of springs have risen. These favorable conditions followed a fall in which the flow from springs was almost nothing in most favored localities and failed completely in others. Sufficient water for the 48-square-mile sanctuary was to be had only by intensive development of a dozen seeps and by the fencing out of domestic stock. As a result, between 1,500 and 1,600 antelope congregated on the range during September and October, sage grouse frequented the springs in more than normal numbers, mule deer moved in from outside areas, and migratory birds, especially doves, showed a large increase. Antelope left the refuge following the first November snows and after wintering well returned in good condition late in March with the beginning of grass growth on the plateaus. The fawn crop appeared normal, twins predominating.

No large increase in total numbers of antelope has been noted on the refuge proper during the past few years. Mule deer, however, are frequenting the refuge more and more and are often seen by day in open areas, but the sage grouse shortage is still acute.

Under the National Recovery Administration development program a barn, a combination implement shed, tool house, and blacksmith shop, a tank house, and a garage have been built, and work has been done for water conservation and for road, trail, and firebreak construction. Some 22 miles of fire trails were constructed for quick entry into sections where the fire hazard would be most pronounced. The erection of the stock fence has stopped the destructive overgrazing by livestock prevalent in the previous years, and the beneficial effects from this improvement were immediate.

A Civilian Conservation Corps camp has been established, and early in June the work program for the refuge was well under way. It includes the building of 48 miles of telephone line, construction of check dams, road and trail development, reseeding, and other beneficial operations.

#### WICHITA MOUNTAINS WILDLIFE REFUGE

Administration of the Wichita National Forest and Game Preserve in Oklahoma was transferred on April 1, 1935, from the Forest Service to the Biological Survey. This area was once part of the Apache, Comanche, and Kiowa Reservation in the old Indian Territory, and when the reservation was thrown open to settlement in 1901, a tract of about 60,000 acres was reserved by Presidential proclamation (32 Stat., pt. 2, p. 1973), as a forest reserve, first under the jurisdiction of the Department of the Interior, and 4 years later under the Forest Service of the Department of Agriculture. In 1905, by a proclamation of President Theodore Roosevelt, based on an act of Congress (33 Stat., 614), the Wichita area was further designated as a national game preserve and by act of March 4, 1907, when all forest reserves were designated as national forests, this area became the Wichita National Forest and Game Preserve.

The preserve supports herds (table 6) of buffalo, elk, and Texas longhorns within fenced enclosures. The area is also well stocked with native white-tailed deer, as well as turkeys, quail, and prairie chickens, and 49 different species of birds have been noted there in a single week. Under the administration of the Biological Survey part of this game preserve will constitute a major wildlife research station, where much-needed investigations will be made of big-game animals as well as of upland game and migratory birds.

Under Public Works Administration and Emergency Conservation Works programs, 22 small lakes have been developed to serve as resting grounds for migratory birds and possibly in the future as breeding and nesting areas for certain species. Considerable road work, camp-ground development, landscaping, dam construction, and many other improvements have been accomplished.



## CONSERVATION THROUGH LAW ENFORCEMENT

## FEDERAL STATUTES ADMINISTERED

Educational methods as well as the strong arm of the law are used by the Biological Survey in the enforcement of the statutes for which it is responsible. These include legislation under the Migratory Bird Treaty, negotiated in 1916 to protect birds that are the common property of the United States and Canada, as follows: The Migratory Bird Treaty Act of 1918, authorizing regulation of wild-fowl hunting; the Migratory Bird Conservation Act of 1929, authorizing the establishment of bird refuges; and the Migratory Bird Hunting Stamp Act of 1934, under which waterfowl hunters are required to have a Federal hunting stamp in their possession. Other wildlife conservation laws assigned to the Bureau for administration are the Lacey Act of 1900, to regulate interstate and foreign shipments of wild mammals and birds; a law protecting animal life and property on Federal wildlife refuges; and, through the Alaska Game Commission, the Alaska game law of 1925.

The Hunting Stamp Act and the Lacey Act were amended on June 15, 1935, in the interest of more effective administration. The amendment to the former makes the stamp readily available to nonhunter purchasers wishing thus to aid in the program of refuge establishment; and in the case of a hunter it requires validation in the form of his signature across its face in ink. The original Lacey Act was limited in scope, covering shipments made by common carrier only; the amendment makes it applicable to shipments of any character in interstate or foreign commerce. The penalty for violation of the statute is now substantially increased, and it also carries full authority for enforcement.

## REGULATORY ACTION

A most informative meeting of the advisory board, Migratory Bird Treaty Act, was held in the new auditorium of the Department on July 11 and 12, 1934, with 21 members in attendance. In the absence of the Secretary of Agriculture, the board was welcomed by the Assistant Secretary and instructed as to procedure. It heard several members of the Bureau present facts that had been collected with respect to the abundance of waterfowl, nesting investigations, migration statistics, and lines of flight, and the plans being made for the waterfowl-restoration program. Maps of the waterfowl flyways and charts indicating the ratio of kill and the breeding areas, also were displayed and explained.

The regulations for 1934-35, approved by the President on August 20, 1934, provided among other things for a complete readjustment of States for hunting waterfowl, jacksnipe, and coot, the season being reduced from 60 shooting days to not exceeding 30, selected by the State game officials of each State between the period October 1 and January 13. By a further amendment the taking of doves was not permitted by means of bait, and the taking of migratory waterfowl by means of bait was allowed only where operations were conducted under permit from the Chief of the Bureau of Biological Survey, the permittees being required to keep records and at the end of the season to furnish information as to the kill of waterfowl by species, and also to indicate the number of hunters, the total number of days they were shooting, the kinds of food employed, and the intervals of feeding the birds. Other amendments made the hours for hunting certain migratory game birds run from sunrise to sunset, instead of from half an hour before sunrise to sunset; and cut the bag limit on certain imperiled ducks from 8 to 5 a day and reduced the possession limit of such birds from 16 to 10.

An amendment to the regulations approved on February 2, 1935, placing a three-shell limit on autoloading and other repeating shotguns in the hunting of migratory game birds becomes a part of the regulations effective with the hunting season for the fall of 1935, which were approved by the President after the close of the year being reported upon.

After press announcement of the details of the changes, the regulations for 1934 were published in the Service and Regulatory Announcements series (BS-79), and the open season dates were shown on a poster (no. 54-Bi) issued on August 31. Other publications relating to the enforcement of conservation laws included the annual bulletin on the game laws (Farmers' Bull. 1742), having on the title page a reproduction of the hunting stamp for the year; a mimeographed abstract of the State fur laws affecting trapping seasons; the annual directory of Federal, State, and Canadian game-protection officials

(Misc. Pub. 211); and in the 1935 Yearbook of Agriculture (p. 724) a table on hunters' licenses issued by States, with total money returns for the seasons 1932 and 1933. Many press statements on these and other conservation subjects were issued during the year for educational purposes and to apprise the public of changes in the regulations (including those under the Alaska Game Law—Alaska Game Commission Cir. nos. 11 and 12).

Visual information on game conservation included specially prepared exhibits displayed by the Bureau at sportsmen's shows and at expositions featuring wildlife subjects. One emphasized the need and value of farmer cooperation by use of uncultivated parts of the farm as breeding, feeding, and resting areas for wild fowl and other game. Another described land areas being acquired for waterfowl refuges. Two other exhibits stressed the decrease of shore birds and upland-game birds and the need for protection through restrictions on hunting and for general observance of the game laws and regulations.

#### ACTIVITIES OF UNITED STATES GAME-MANAGEMENT AGENTS

Advances on proceeds of sales of migratory-bird hunting stamps permitted increasing the regular force of 22 United States game-management agents to 25, and employing 32 deputies. All were selected in accordance with civil-service regulations, to work from October to April. For enforcement purposes the country was divided into eight regions in charge of regional directors who supervise the operations of the game-management agents and deputies. Each agent is held directly responsible for Federal game-law observance within his district. The deputy agents were organized in 8 mobile units, or "flying squadrons," of 4 men each, to patrol the major waterfowl-concentration areas. They were available also at all times on call to assist any game agent in apprehending violators.

As the migratory birds moved south with the approach of cold weather, the northern agents and squadrons worked southward with them and patrolled the Southern States all winter. When the waterfowl returned on their spring migration, the first flights were accompanied by the northern agents and squadrons. Later, as the majority of the ducks and geese were leaving the South, the southern agents and deputies in turn followed. This method of game protection proved very satisfactory, as several relays of trained enforcement officers were continuously available to patrol the major flyways as the birds crossed the country to their nesting grounds. News of the presence of the officers spread like wildfire, and soon the violators were on the run. A number were caught red-handed, some sought avenues of escape, and many other former spring shooters, fearful of apprehension and unwilling to assume the risk, were content to leave their guns on the rack.

In most States enforcement activities had the hearty approval of the game commissions, and in several the State game wardens and Federal agents worked together in a coordinated program that produced gratifying results. The combined forces not only apprehended many well-known and persistent game-law violators, but the cooperative patrol in the intensified campaign saved thousands of migratory birds that otherwise would have been illegally killed by trapping and shooting. A few instances of excellent enforcement work may be cited from a large number in many States to present a clear picture of the nature and extent of the field work of the agents and deputies.

To cut off the supply and combat the illegal sale of ducks and geese in night clubs, hotels, and cafes, it was necessary to detail a few agents to undercover work. Such methods were used, however, only against persons and establishments known to handle game illegally and for profit. One agent and a deputy effectively posed as surveyors and ran a line directly through a duck-supply depot, where they found several hundred dead wild ducks and geese that were being held for disposal to an exclusive trade.

To another agent was assigned the duty of posing as a professional duck buyer for exclusive night clubs in Chicago. During his operations he bought ducks killed illegally from 44 well-known duck bootleggers. In this operation the agent worked with a man who was familiar with the haunts of the outlaws, and the two, with heavy growths of whiskers, looked like kindred spirits. The agent himself was so disreputable looking that the hotel clerk made it evident that he feared he would not be paid for the accommodations furnished, and later looked on with awe when the agent, on checking out, produced a sizable roll of greenbacks. Nearly all the cases have been handled successfully in Federal court.



Other agents, in the guise of wealthy salmon packers, entered exclusive western night clubs and cafes and were served wild duck. These and other similar operations of game agents and deputies resulted in more than 100 arrests and convictions in Federal courts for the sale of waterfowl.

Because of known violations on an island in eastern waters, an agent performed under-cover work with the aid of a special agent from the Department of Justice. As no stranger could approach the island unobserved except after midnight, the agent made his visit in another role, in order to allay any suspicions and build up some sort of friendly relationships. Before being accepted by the islanders, the Bureau's agent first had to submit to lengthy questioning as to whether he was not a State game warden. To obtain the facts he posed as a collector of birds and made up the skins in the presence of onlookers. He hired one or more of the local residents as guides, and thus was enabled to obtain much of the information he was seeking, and incidentally learned what would happen to any game warden who might come snooping around. The agent was able to watch the trapping and unlawful shooting of ducks, and to obtain data regarding the market for them. Many of the trappers were persons without other means of support than that derived from the sale of fish and ducks.

To obtain respect for the Federal law, the agent afterward decided to undertake an educational campaign with the aid of the local minister. Becoming to all intents and purposes one of the islanders, he lived with them for several weeks and attended their church. As a result he was able to have removed from the island 3 large-bore guns 8 to 10 feet long and weighing as much as 175 pounds. The educational program was actually productive of fine results, and the means of saving many birds.

A skillful piece of work in connection with duck trappers was done by an agent operating in the same general region. He learned that ducks were being shipped in eel kegs to New York, Pennsylvania, and Illinois. Inquiry disclosed that the shipper was using the name of a person who had been dead some months. This handicap did not serve to stop the agent, and by persistence and a process of elimination he finally located and arrested the violator. This man was afterward arraigned in Federal court and sentenced to serve 6 months in jail on 1 count. On 4 remaining counts he was sentenced to serve 6 months each, the terms to run consecutively, but suspended for 5 years, with a reminder by the court that if he were ever arraigned again on a game-law violation, he would have to serve this additional sentence.

Two agents in a southern State watched 5 hunters shoot simultaneously at ducks and assisted them in picking up 112 birds, which they then seized. One of these agents also apprehended 7 persons killing plovers. Four of these hunters were officers on a city police force, 1 was assigned to the city prison farm, and 2 were prominent citizens. Incidentally they had been transported to the shooting grounds, some 40 miles from town, in police radio cars. Fines of \$100 each were suspended in these 7 cases, conditioned upon the offenders refraining from any form of hunting for 1 year.

Several hundred waterfowl traps were destroyed during the year. Three swivel guns, types capable of great duck and goose destruction, killing 100 or more birds at one shot, were confiscated. The smallest gun has a 1¾-inch bore and is 7 feet 9 inches long, while the largest is 9 feet 6 inches long and has a 2-inch bore.

#### HAZARDS OF THE WORK

On December 10, 1934, a fearless and efficient veteran game agent of the Bureau, E. Bradford Whitehead, lost his life in line of duty, from wounds received 2 days before at the hands of a game-law violator. The assault occurred near Savannah, Ga., when the Federal officer, while inspecting the hunter's game bag, received a charge of buckshot in the left side, shoulder, and arm. Within an hour after the shooting, the assailant himself, while attempting to escape arrest, was shot and killed by State officers. Because of the continued assaults of this kind, the Bureau is keenly interested in pending legislation to provide punishment for the killing or assaulting of Federal officers; this bill (H. R. 7680) has passed the House of Representatives and was reported favorably by the Senate Committee on the Judiciary.

Assistance rendered by the Coast Guard in February saved a deputy game-management agent of the Bureau from death by freezing and starvation when for 10 days he was marooned in subzero weather on an island in Chesapeake

Bay, Md. The agent was doing law-enforcement work in the section and assisting in the Bureau's January waterfowl inventory, when a 2-day rain suddenly turned to sleet and snow. Having food and supplies for only 2 weeks, he was sharing them with a private trapper who sought shelter from the storm on the island. The plight of the two men was discovered by an airplane which was sent out by a Washington newspaper to search for the deputy and to drop food to the island, after which a cutter of the Coast Guard, breaking through the ice, reached the men and made the rescue. A commercial airship which also had gone from Washington to effect the rescue arrived and landed a searching party shortly afterward, only to discover that the men had been removed.

## LAW VIOLATIONS AND PENALTIES

### MIGRATORY BIRD TREATY ACT CASES

There was an increase of 163 over the preceding fiscal year in the number of cases of violation of the Migratory Bird Treaty Act reported by the Department for prosecution, an increase in convictions, and a slight decrease in the number of cases disposed of (table 7).

On account of lack of evidence, youthfulness of the accused, or other satisfactory reasons, 73 cases were not recommended for prosecution. Fines and costs ranging from \$1 to \$500 and aggregating \$7,156 were assessed in the Federal courts. Jail sentences were imposed as follows: 10 days (10), 20 days (1), 30 days (12), 60 days (9), 90 days (2), 120 days (1), 180 days (1).

In 18 cases jail sentences ranging from 10 days to 6 months were suspended. Defendants in 54 cases were placed on probation for 6 months to 5 years. One case tried before a jury resulted in a verdict of guilty. Seizures of migratory game birds had an estimated value of \$1,400, and such birds as could be utilized for food were donated to hospitals and other public charitable institutions.

Demurrers filed at St. Louis, Mo., by two persons charged with killing mourning doves by means of bait, contending that the Migratory Bird Treaty Act was an attempt by Congress to delegate legislative powers to an administrative officer and therefore unconstitutional, were overruled by the court on April 24, 1935.

TABLE 7.—*Cases of violation of the Migratory Bird Treaty Act disposed of during the fiscal year and cases still pending June 30, 1935*

Cases disposed of	Number	Cases pending	Number
Convictions.....	358	Pending from former year.....	349
Dismissals.....	29	New cases.....	615
Verdicts of not guilty.....	8		
Adjudged guilty by the court.....	3	Total.....	964
No bills found.....	2	Disposed of.....	424
Not-prosessed.....	18		
Prosecutions abandoned.....	6	Pending at end of year.....	540
Total.....	424		

In California a well-directed drive culminated in obtaining evidence against 47 duck sellers, including night clubs and restaurants. Of this number 33 cases were prosecuted in State court, where fines aggregating \$2,495 were imposed. The remainder, 14 cases, have been successfully terminated in Federal courts in California, with fines running as high as \$500, and aggregating \$1,700. In two of the cases the defendants were sentenced to serve 30 and 90 days, respectively, in jail.

A vigorous campaign in Louisiana against out-of-season shooters and sellers of wild fowl resulted in the apprehension of 72 individuals. In 3 cases the jury returned a not-guilty verdict. Most of the remaining cases have been terminated, with jail sentences as high as 120 days in 16 cases.

On the Susquehanna Flats in Maryland agents found the guns, hunting coats, and licenses of hunters and several bags of freshly killed ducks—39 canvasbacks and 45 scaups. Three hunters afterwards charged with possessing ducks in excess of the bag limit paid fines and costs of \$47.50 each. In one other case in the same district the court, in imposing a fine of \$100 against a restaurant operator charged with selling 6 ducks, indicated in emphatic language that the commercial handling of wild fowl is a serious offense and completely subversive of the purpose of the law.



## MIGRATORY BIRD CONSERVATION ACT CASE

The first case under the Migratory Bird Conservation Act, which was based on the unlawful taking of 1,350 turtle eggs on the Cape Romain Migratory Bird Refuge in South Carolina, was reported during the year.

## MIGRATORY BIRD HUNTING STAMP ACT CASES

Three cases involving infractions of the Migratory Bird Hunting Stamp Act were reported for prosecution, of which 2 were terminated, 1 in Virginia and 1 in Louisiana, by fines of \$10 each. The activities of agents under this statute were chiefly of an educational nature during the first year. Many sportsmen who had not yet become familiar with the provisions of the law were cautioned to stop hunting and given opportunity to purchase the required stamp.

## WILDLIFE REFUGE TRESPASS CASES

Three new cases under the law protecting wildlife and Government property on Federal reservations (sec. 84, Criminal Code) were reported for prosecution, 1 in Nebraska, 1 in New Jersey, and 1 in Wyoming.

## LACEY ACT CASES

One case, still pending, involving the unlawful interstate shipment of a deer from Michigan to Ohio, was reported for prosecution during the year. Agents working under the Lacey Act inspected records of fur at receiving centers in 14 States and discovered evidence of many infractions of State game laws. Information regarding 2,361 shipments containing skins of fur-bearing animals illegally taken or shipped were transmitted to State game departments in 22 States and Alaska. In 13 States 74 cases based on information originally furnished by the Survey were closed by fines and costs of \$1,217, and in 2 of these States jail sentences from 5 to 30 days were imposed in 5 cases. In 834 other investigations reported on by the States it was determined that shipments had been lawfully made, and in 116 others that prosecution would be inadvisable. The game departments of 42 States were furnished evidence regarding 608 cases involving violations other than illegal interstate shipments of skins of fur-bearing animals. As a result of these prosecutions, fines and costs in State courts amounted to \$11,461.10. In 2 cases the defendants were adjudged not guilty. In 438 cases convictions were obtained, while in 170 cases prosecution was not deemed desirable. Jail sentences were imposed against 14 offenders, while additional fines aggregating \$512.75 were suspended.

## UPPER MISSISSIPPI RIVER WILDLIFE REFUGE CASES

During the year 16 new cases indicating violations of the Upper Mississippi River Wild Life and Fish Refuge Act were reported for prosecution, of which 1 was disposed of by a suspended fine of \$50, 1 by a 2-day jail sentence, 2 by suspended jail sentences of 1 year each, 1 by a suspended 3-month jail sentence, and 1 was nol-prossed.

Reservation protectors reported 52 cases relating to State game-law offenses, and of this number 21 cases resulted in convictions, in 8 the defendants were found not guilty by juries, in 11 suspended sentences were imposed, while 3 cases were dismissed. Jail sentences of 30 days each were imposed in 3 cases, 60 days each in 2 cases, and 90 days in 1 case. In 3 other cases the prisoners escaped from jail prior to trial. The fines and costs collected aggregated \$739.39.

Joint regulations for the administration of this refuge were prescribed by the Secretaries of Agriculture and Commerce in September, and published as a Service and Regulatory Announcement of the Biological Survey (no. 80).

## WILDLIFE CONSERVATION IN ALASKA

## LAW ENFORCEMENT

Several changes were made in regulations for the 1935-36 hunting and trapping seasons under the Alaska Game Law. A close season was established for marten and beaver throughout the Territory, and bears were given added protection through close seasons and smaller bag limits in some sections. As a result of unusual increase of the Sitkan deer transplanted to the Prince

William Sound region from southeastern Alaska several years ago, a short open season, during which 1 male deer may be taken under special permit, was granted for the new district. Acting under authority given it under the Alaska Game Law, the Bureau's operating agency in the Territory—the Alaska Game Commission—initiated a \$1 resident hunting license in the first judicial division.

Working under a handicap of sharply reduced funds, the active field force was held to but seven wardens to police a wilderness area nearly 590,000 square miles in extent. Patrol vessels were unable to operate sufficiently to keep pace with increased violations, and the executive office staff suffered curtailment with like effect. An allotment of \$195,700 by the Public Works Administration during the previous year did, however, make it possible to construct six urgently needed patrol vessels, besides docks, floats, small storehouses, and administrative buildings for field offices and warden's living quarters.

#### WILDLIFE RESTOCKING PROJECTS

At a total expense of \$462.36 provided by the Territorial Legislature, 225 Chinese ring-necked pheasants were transplanted from the State of Washington to the vicinity of Sitka on Baranof Island during the summer of 1934. The small herd of Roosevelt elk transplanted to the Kodiak-Afognak Islands group 6 years ago has shown a gratifying increase. In September 1934 a warden of the Commission obtained first-hand information that between 50 and 60 of these animals are now on the islands. In the Big Delta section of central Alaska approximately 75 bison are now thriving as a result of the transplanting of 23 animals from the National Bison Range, Mont., in 1928. These buffalo have never required artificial feeding in Alaska even during the severest winters. Numerous other plantings, including those of beaver, muskrat, marten, hare, squirrel, marmot, mountain goat, and deer have on the whole shown such results as to warrant continuance of this type of wildlife conservation.

#### INFLUENCE OF CHANGING ECONOMIC CONDITIONS

During the 10 years that the Alaska Game Law has been in operation, noticeable changes have occurred in the attitude of residents toward wildlife resources. At first there was much chafing at restrictions, the general feeling being that the game and fur was for the people to take as they saw fit, but as time has passed and the Commission's purposes have become better appreciated, there has been a slow but steady trend toward reasonable protection of wildlife. Changing economic conditions have emphasized the importance of fur and game animals in the lives of the people, and have forced a realization that for many years to come these resources must be relied upon by a large proportion of the population as a means of livelihood, and therefore must be safeguarded for them by some reliable agency. With this thought has come a clearer conception of the benefits to accrue from the annual visits of numbers of sportsmen and big-game hunters to the Territory and their spending of many thousands of dollars for a relatively small number of game trophies.

#### IMPORTATION AND OTHER PERMITS ISSUED

##### PROHIBITED SPECIES EXCLUDED

It continues a fact that no forbidden species of bird or mammal has established a foothold in the United States since the passage of the Lacey Act in 1900; and that the English sparrow and starling population, then established, has not been augmented by any importations.

During the year two attempts were made by importers to bring flying foxes, or fruit bats (*Pteropus*), into this country. In the first, 4 bats were actually entered and, in violation of the regulations, immediately shipped from New York City to Chicago, having been listed in the application as "flying dogs", and the application for the permit, including a large number of miscellaneous mammals and birds, was not sent to the Department until several days after the importation. Permit was withheld and the Bureau's inspector at New York promptly directed to identify the animals. On ascertaining that they were fruit bats, the Bureau notified the collector of customs at New York, whereupon inspectors of the Customs Service in Chicago promptly sought, seized, and destroyed the bats, notwithstanding vigorous protest by zoological-park officials. Like disposition was made of another bat at New York before it reached its destination on



Staten Island. In this case the application for the permit was sent prior to the arrival of the consignment, and the bat was listed as such.

Seven common Indian mynas (*Acridotheres tristis*), an injurious species not permitted entry by either Federal or California law, arrived at San Francisco in March. After identification by the inspector, the birds were returned to the shipper in Papeete, Tahiti, on the steamer that brought them in.

### SPECIES ENTERED UNDER PERMIT

#### BIRDS

Importation permits issued during the year numbered 1,475, an increase of 289 over the number in 1934, and inspections decreased from 175 to 145. Fourteen additional permits were issued at Honolulu, Hawaii, for the entry of 136 miscellaneous birds. The 197,100 foreign birds imported (a decrease of 66,635 from last year) included 138,756 canaries, 1,783 parrots, 23,358 Mexican quail, 6,000 valley quail, 2,211 Hungarian partridges, 203 pheasants, and 24,789 miscellaneous birds.

Bolwhite quail were imported from Mexico to the number of 23,358, nearly 10,000 more than last year. Mexican Government concessions had been granted to five individuals for the exportation of 65,000, the entries of which were made at the ports of Eagle Pass and Laredo, Tex., where health examinations were made and permits issued by inspectors of the Bureau of Animal Industry, cooperating with this Bureau. The quail were shipped mainly to nine States, as follows: Texas, 11,735; Indiana, 7,240; Kentucky, 1,500; Mississippi, 1,326; Arkansas, 400; Florida, 200; Illinois, 184; Georgia, 150; and Missouri, 126. Of the remainder, small lots were shipped to New York, Pennsylvania, California, Wisconsin, Tennessee, and Louisiana.

About 6,000 valley quail were imported from Baja California by the California Fish and Game Commission for stocking purposes in southern California.

Hungarian partridges continued to be imported from Canada principally for stocking purposes in Ohio and South Dakota. Twenty-six chukar partridges (*Alectoris graeca chukar*) were imported from India.

Pheasants of several species were entered, including 25 copper pheasants (*Graphephasianus soemmerringii*) and 4 Mikado pheasants (*Symptotylus mikado*) from Japan, 2 crossbilled pheasants (*Crossobillia crossobillia*) and 4 Lady Amherst pheasants (*Chrysolophus amherstiae*) from China, 3 Malay crested fire-backed pheasants (*Lophura rufa*), and 4 argus pheasants (*Argusianus argus*) from Singapore, Straits Settlements.

To prevent psittacosis, the Public Health Service still limits the importation of parrots to birds 8 or more months old and continues the 15-day quarantine and the restrictions on interstate transportation. Among the more interesting parrots imported were 2 Finsch's parrots (*Amazona finschi*) and 2 Petz parakeets (*Eupsittula canicularis*) from Mexico; 1 eclectus parrot (*Eclectus roratus*), 2 cockatoos (*Kakatoe haematuropygia*), 1 mealy rosella parakeet (*Platycercus adscitus palliceps*), 2 blue mountain lorries (*Trichoglossus moluccanus*), and 1 blue-tailed lory (*Eos histrio*) from the Philippine Islands; and 1 tovi parakeet (*Brotogeris jugularis*) from the Canal Zone.

Other rare and interesting birds imported during the year included 6 Comoro weaver birds (*Foudia eminentissima*), imported into the United States for the first time; 12 Japanese waxwings (*Bombicilla japonica*); 6 buffalo weaver finches (*Dinemellia dinemellia*), 2 dwarf hornbills (*Tockus erythrorhynchus*), 3 Siamese raven hornbills (*Hydrocissa convexa*), 6 dwarf falcons (*Polihiæra semitorquatus*), and 2 barn owls (*Tyto alba*) from Africa; 1 black Indian cuckoo (*Eudynamis scolopacea*), 4 black-chinned flowerpeckers (*Yuhina nigrimenta*), and 5 blue-cheeked barbets (*Cyanops asiatica*) from India; 1 Sumatran barbet (*Thereiceryx zeylanicus*) and 6 bar-shouldered doves (*Geopelia humeralis*) from New South Wales; 6 Ridgway's scaled doves (*Scardafella ridgwayi*) and 17 bell birds (*Casuarinichos nudicollis*) from Brazil; 2 stilts (*Himantopus melanurus*) and 4 blue and yellow tanagers (*Thraupis bonariensis*) from Argentina; 40 emerald tanagers (*Tangara guttata chrysophrys*) from Venezuela; 2 tanagers (*T. fastuosa* and *T. cyanocephala*), 1 black-faced tanager (*Schistochlamys atra*), 1 Diuca finch (*Diuca diuca*), and 1 red-breasted blackbird (*Trupialis defilippii*) from South America; 5 amethyst doves (*Phapitreron amethystina*) and 1 yellow-breasted fruit pigeon (*Leucotreron occipitalis*) from the Philippine Islands; 30 Abyssinian sun birds (*26 Cinnyris cruentata* and 4 *Cinnyris habessinica*), 21 lavender finches (*Estrilda caerulescens*), and 4 red-

crested finches (*Coryphospingus cucullatus*) from Holland; and 2 black-footed albatrosses (*Diomedea nigripes*) from Midway Island.

Near the close of the year application was made by the Byrd Antarctic Expedition for a permit to bring in 7 emperor penguins (*Aptenodytes forsteri*) and 1 Adelie penguin (*Pygoscelis adeliae*), taken in the Antarctic region, and 8 Galapagos penguins (*Spheniscus mendiculus*), obtained en route home. The Antarctic birds were transported in glass-enclosed refrigerators at a temperature of 30° F. With the exception of 2 Galapagos penguins retained by Admiral Byrd, all were sent to the Chicago Zoological Park.

#### MAMMALS

Black bear cubs from Canada, consigned principally to points in New Jersey, New York, Pennsylvania, and Minnesota, continued to be imported, the number aggregating 128 as compared with 96 last year. A few polar bears from Norway and a few cinnamon bears from Mexico also were imported.

Importations of monkeys included 5,073 rhesus monkeys from India and others in considerable variety, including chimpanzees, baboons, colobus monkeys, macaques, and bush monkeys from Africa and India; ringtails, marmosets, and woolly and moss monkeys from Central and South America; sykes and patas monkeys from Java; and 1 gorilla from West Africa. Among the monkeys was an exceedingly rare albino from the jungles of Colombia, South America, presented to the Central Park Zoo, New York City. About 10 years ago, it is reported, an albino like this one was found, but it died before it was 6 months old.

Other interesting mammals imported were 1 lion marmoset (*Leontocebus rosalia*) from Brazil; 1 hoolock monkey (*Hyllobates hoolock*) from Hong Kong; 2 sea elephants from Guadalupe Island, Mexico, for exhibition at the San Diego (Calif.) Exposition; 4 vampire bats (*Desmodus rufus*) from Trinidad, British West Indies; 1 honey bear (*Ursus malayanus*) from the Malay Peninsula; 1 Arabian fox (*Fennecus famelicus*) from the Persian Gulf region; and 1 zorilla (*Ichtonyx zorilla*) and 2 manatees (*Manatus americanus*) in miscellaneous shipments from Germany.

#### COLLECTING AND OTHER PERMITS ISSUED UNDER THE MIGRATORY BIRD TREATY ACT

One of the amendments of the Migratory Bird Treaty Act regulations, effective August 20, 1934, made the permits issued for collecting migratory birds for scientific purposes annual rather than indefinite or unlimited. Representations having reached the Bureau from various credible sources that such permits in some instances were being misused, all those outstanding were recalled, and new, annual permits were issued only in those cases where it could be determined that the applicant was well qualified for the privilege. The rule was also established of not including in taxidermists' permits the privilege of buying and selling specimens, as such a practice has lent itself to too many abuses incompatible with adequate protection of migratory birds.

There were outstanding at the close of the year 1,207 permits to collect migratory birds for scientific purposes and 3,878 for possessing, buying, and selling migratory waterfowl for propagation.

Only 52 permits were issued to capture migratory waterfowl for propagation. Reports of permit holders during the calendar year 1934 showed 54,737 wild ducks raised in captivity, of which 48,080 were mallards and 5,793 black ducks, the others mainly wood ducks, pintails, teals, gadwalls, canvasbacks, baldpates, and redheads. The number of wild geese raised under permit was 4,518. Migratory birds propagated and reported sold during the year included 7,488 ducks and 214 geese for food, and 7,090 ducks and 3,156 geese for propagation. To conserve the breeding stock of wild ducks and geese, the Department in April discontinued the issuance of permits to take waterfowl and their eggs for propagation, except for State refuges or in rare instances where experienced commercial breeders require the replenishment of wild stock.

#### BAITING PERMITS

The first Federal restrictions on waterfowl baiting, a practice now outlawed, were imposed by amendment of the Migratory Bird Treaty Act regulations for the fall and winter of 1934-35. The amendment provided for a seasonal permit to be issued without charge by the Bureau, with the conditions that no



waterfowl, except crippled birds not otherwise retrievable, should be shot while resting on water or land on any baited premises; that no waterfowl should be shot on such premises after 3 p. m.; that every permittee should keep an accurate record of the number of persons shooting on such premises, the number of blinds used, the number of each species killed, the number of birds taken each day by each gunner, and the kinds of feed and the interval of feeding; and that report of these facts be made to the Bureau within 1 month after the close of the season. Provision was made for revocation of the permit by the Secretary upon his determination that baiting on any premises constituted a disproportioned agency in the killing of migratory waterfowl, or for violation of any of these requirements. The amended regulation defined "bait" and "premises" with particularity, notwithstanding which the Bureau was called upon to answer numerous inquiries as to the scope and effect of the amendment, many of them being obviously captious or insincere, or proceeding from a hope of escape from the force of the regulation.

Because of restrictions on baiting imposed by State law, no permits were issued in Alabama, Florida, Georgia, Iowa, or Minnesota, and no applications for permits were received from Idaho, Kansas, New Hampshire, Utah, West Virginia, or Wyoming. The bulk of applications were from California, 295; Illinois, 735; Maryland, 485; Missouri, 102; Oregon, 242; Virginia, 311; and Washington, 198. In the other States from which applications were received, the number in each was below 100, including New York, 90; North Carolina, 95; and Ohio, 65. Only 1 application each was received from Kentucky, Nevada, North Dakota, and Pennsylvania, and only 2 each from New Mexico, Oklahoma, and Texas.

The total number of baiting permits issued was 3,003, and the reports filed by practically all permittees, show that 44,349 gunners shot in the aggregate 673,083 birds on baited premises, the bulk of these being made up of 237,893 mallards, 187,452 pintails, 61,820 teal, 51,630 widgeons, 35,687 black ducks, and 29,834 scaups; and 3,628 coots were included. The kill of Canada geese aggregated 10,399; brant, 739; whitefronted geese, 441; and snow geese, 180. Mergansers to the number of 746 were reported. The largest kills of waterfowl on baited premises were in California, 210,258; Illinois, 166,014; Washington, 75,103; Oregon, 62,746; Maryland, 37,184; Missouri, 20,574; Ohio, 14,817; Virginia, 14,327; North Carolina, 13,781; and New York, 13,715.

Before the close of the season, 126 permits were surrendered on the cessation of baiting on the premises covered, and 3 permits, 1 each in Illinois, New Jersey, and Washington, were revoked by order of the Secretary, upon information that one or more terms of the permits had been violated.

## COOPERATIVE CONTROL OF PREDATORS AND RODENTS

### ABUNDANCE OF PREDATORS INCREASING

In spite of a large catch of predatory animals, several factors have operated to increase their numbers, especially those of coyotes, in most sections of their range. Among these factors are decreased cooperative personnel in organized control; inactivity among private trappers, because of extremely low fur prices; and the great fecundity of the predators.

Expenditures during the year in predatory-animal and rodent control operations, in addition to about \$900,000 from emergency funds, included \$441,354 from regular departmental appropriations, supplemented by \$253,365 spent by cooperating States and \$619,374 by cooperating counties, livestock associations, and others. The year's catch of predators, 66,662—the largest ever taken in 1 year by the Bureau and its cooperating agencies—consisted of 59,289 coyotes, 1,332 wolves, 5,380 bobcats and lynxes, 7 ocelots, 305 bears, and 349 mountain lions. Rodent control involved the treatment of 32,751,372 acres infested with prairie dogs, ground squirrels, pocket gophers, jack rabbits, porcupines, field mice, cotton rats, kangaroo rates, and woodchucks. In addition, 182,333 premises were treated in cooperative campaigns for the control of the common brown rat.

An example of the fecundity of coyotes was furnished in the San Luis Valley of Colorado, where 17 coyote whelps were taken from a single den together with the mother coyote, examination of the uterine scars of which showed clearly that all 17 belonged to the same litter. A second litter of 17 was taken from a coyote den in northwestern Colorado, and a den of 16 wolf whelps was taken in Jefferson County, Okla. On lambing grounds in one

township, 6 miles south of Wolcott, in Carbon County, Wyo., 44 coyote pups and 1 adult were taken from 5 dens, containing 6, 7, 8, 9, and 14, respectively. The stockman apparently had ample reason for complaining of severe losses among his lambs. In the south Texas area, embracing that section of the State south of a line from Victoria to Del Rio, which probably contains three-fourths of the coyote population of the entire State, increasing numbers of reports were received during the year of damage by predatory animals to young deer and calves. In the comparatively small area where some measure of predator control has been attained in Texas, a noticeable increase in the game population has been observed.

Increased abundance of predators has resulted in greater depredations on livestock, game species, and ground-nesting birds. This is evidenced by reports from livestock owners and by observations of the field personnel of the Bureau. The 3-year drought conditions prevailing over a great part of the West have to some extent concentrated the livestock around available water supplies, and as it also had the same effect on the predator population, it may have been indirectly responsible for greater losses in domestic livestock as well as in game species. The fact remains that predators have been more numerous and their depredations more severe, and also that the Federal Government has a distinct obligation to assist in the prevention of undue depredations to livestock and game species ranging on and adjacent to public lands. This obligation is now of direct financial interest to the Federal Government because of its financing loans to stockmen.

#### SELF-PHOTOGRAPHY BY WOLVES

This year for the first time, equipment was developed whereby wolves have photographed themselves in the wild. This was accomplished in a cooperative expedition, undertaken by the Bureau and the Chicago Academy of Sciences, in Madison Parish, La., where, by a special device, flashlights were set off by an electric current closed by the wolf when approaching the set. Several valuable study photographs thus made by the wolves themselves were obtained and published by the academy in its report on the expedition.

#### PROGRESS IN RABIES SUPPRESSION

A summary of examinations made by the Nevada State Veterinary Control Service for the years 1915 to 1933 shows a steady decline in rabies in that State during this 19-year period. Predatory-animal control work was originally inaugurated by the Bureau in 1915 for the primary purpose of stamping out a severe outbreak of rabies in Nevada, and has been largely responsible for its general suppression.

In August 1934, officials of the health and game departments of Maine urged that aid be given in controlling an outbreak of rabies near Farmington. The Biological Survey learned that the trouble was localized in a farming section largely wooded, not over 8 miles in diameter, where 10 foxes with evidence of rabies had been killed during the spring and summer. One boy, 3 cows, and 4 dogs were known to have been bitten by the foxes, and 2 of the cows had died. A rapid spread of the disease among the numerous large and small wild animals was threatened, but acting on the Bureau's recommendation the State game department immediately employed 10 trappers to remove all possible carriers. By October 1 these men had taken 162 foxes, 107 raccoons, 510 skunks, 117 porcupines, 9 minks, 67 woodchucks, and numerous squirrels, muskrats, weasels, and vagrant cats. This action brought the situation under control.

#### NEED FOR RODENT CONTROL CONTINUES

The need for rodent control throughout the Western States has been greatly augmented by the fact that the prevailing severe drought conditions have caused many species to migrate to areas where food supplies were available. This usually resulted in rodent concentrations on cultivated areas and on fertile range lands of more succulent vegetation.

#### BUBONIC-PLAGUE CARRIERS

With the finding of bubonic plague in the Oregon ground squirrel in Lassen County, and in the white-footed mouse in Modoc County, there are now 14 counties in California in which the disease has been demonstrated among native rodents. In California it has now become definitely associated with



4 native rodents—2 species of ground squirrel (*Citellus beecheyi* and *C. oregonus*), the wood rat (*Neotoma cinerea*), and the white-footed mouse (*Peromyscus* sp.), and, in addition, the introduced brown rat (*Rattus*). The fact that the disease has now been established in white-footed mice and that these rodents, as well as wood rats, live in unoccupied habitations of man, increases the public concern, since old cabins, shacks, barns, and cellars are used on occasion by stockmen, ranchers, hunters, and wanderers.

#### EMERGENCY CONTROL PROGRAMS

##### FEDERAL EMERGENCY RELIEF ADMINISTRATION

Cooperation of the Federal Emergency Relief Administration in predatory animal and rodent control in 10 States—Washington, Oregon, Idaho, Montana, Wyoming, Utah, Texas, Massachusetts, Alabama, and Mississippi—accounted for the destruction of 12,695 predatory animals, and the treating of 2,551,026 acres for the control of field rodents and of 139,069 premises in rat-extermination campaigns.

The Montana Relief Commission expended \$48,560 for the control of prairie dogs in a project carried on under the supervision of the Bureau in 8 counties of eastern Montana. In the course of the work 450,000 acres of prairie-dog-infested territory were treated, more than 64,000 man-hours of employment were provided in a drought-stricken area, and checks were issued to laborers amounting to \$37,733. In the more heavily infested districts this rural project reached and directly benefited practically every individual. For years ranchers in this section individually had been making futile attempts to control prairie dogs, and it was not until the concerted action of this year was taken that success was attained. The presence of millions of prairie dogs competing with livestock on the range during drought periods is a matter of serious concern to stockmen. In many instances, in Custer, Powder River, Carter, and Rosebud Counties in this campaign, these rodents were found virtually in possession of the most desirable grazing areas on section after section of contiguous land, and they were rendering unproductive thousands of acres of otherwise valuable stock lands.

##### PLAINS SHELTERBELT PROJECT

In cooperation with the Plains shelterbelt project of the Forest Service, in the strip extending from North Dakota to Texas, through South Dakota, Nebraska, Kansas, and Oklahoma, 125 miles of shelterbelt plantings were furnished with protection against rodent damage. Investigations were first carried on through this strip to determine the most effective methods of controlling rodent pests as they affect shelterbelt plantings. Jack rabbits and pocket gophers are especially destructive, the jack rabbits doing damage to young trees from aboveground, while the pocket gophers attack the roots. Such a menace are these mammals to young trees that, if not kept under control, they will jeopardize the shelterbelt plantings during the period the trees are attaining some size.

##### NATIONAL INDUSTRIAL RECOVERY ADMINISTRATION

Emergency P. W. A. funds transferred to the Bureau from the Forest Service made it possible to treat 1,864,389 acres of national forests for the control of prairie dogs, ground squirrels, kangaroo rats, pocket gophers, and porcupines in nine States—Oregon, California, Idaho, Nevada, Utah, Wyoming, Colorado, New Mexico, and Arizona.

##### EMERGENCY CONSERVATION WORK

Rodent control was continued as a project in Emergency Conservation Work in cooperation with the Forest and Soil Conservation Services, of the Department of Agriculture, the Office of Indian Affairs, the Bureau of Reclamation, and the Division of Grazing, of the Department of the Interior, and on big-game preserves of this Bureau. Under the program drawn up it was possible to treat 1,886,395 acres of national-forest lands, 138,960 acres on soil-conservation projects, 3,877,897 acres of Indian lands, 59,300 acres on reclamation projects, 161,185 acres of public domain, and 43,395 acres on big-game refuges for the control of injurious rodents, the work of which, in destroying range grasses and other soil cover was contributing measurably to the erosion of

valuable surface soil. On Indian reservations capable foremen were placed in charge of crews of Indian laborers. The Indians, noticing the good results obtained by taking the rodents from their farm lands and adjacent areas, worked with renewed interest and vigor to benefit as much as possible from the project. By reducing the rodent population over wide areas in the cooperative work, great reservoirs of breeding rodents that had for years constantly reinfested adjacent cleared agricultural lands have been held in check. The reduction in the rodent population is now making it possible for the grass to grow on extensive areas in arid and semiarid regions. With such rehabilitation of the ground cover, disastrous erosion of the soil will naturally be lessened in intensity in places where it is now noticeable, and will be prevented on other large areas.

#### DROUGHT-RELIEF PROJECTS

Drought-relief funds aggregating \$15,000, provided for the control of rodent pests on drought-stricken areas in Idaho, made it possible to reduce the rodent population on 593,445 acres. The State drought relief committee estimated that a net saving of more than \$400,000 worth of range forage, feed, and grain crops resulted from the jack rabbit control work alone, which was conducted on 425,776 infested acres.

Damage to farm products by the drought was further aggravated wherever the jack rabbits congregated in hordes to find an available food supply. This situation was emphasized in eastern Colorado by a petition, bearing the signatures of more than 9,000 persons, asking for immediate assistance looking toward the elimination of jack rabbits that were devouring what little livestock food remained after the drought of 1934. Incidentally, these petitions requested that the Federal Government provide a bounty of 10 cents a head on jack rabbits, but the Bureau's experience has shown that the payment of bounties is a most unsatisfactory means of controlling mammal pests, and that much better results can be obtained by organized control carefully planned and supervised by expert leaders.

#### BAIT-MIXING STATION

The Bureau's cooperative bait-mixing station at Pocatello, Idaho, has been a primary factor during the past season in the efficient conduct of rodent-control campaigns, not only on regular projects, but on those financed through emergency funds as well. Scientifically treated baits prepared at this station were utilized in Emergency Conservation Work operations on Indian Service, Forest Service, and Division of Grazing Lands, and on Biological Survey refuges; in National Recovery Administration work; and in soil-conservation cooperation; and also in regular Federal work and cooperative programs with States, counties, farm bureaus, and other organizations. Since its inception the station has shown a yearly increase in production and service. New mechanical devices added to the equipment from time to time have made possible a bait that is much more uniform than heretofore and gives greater success under field conditions.

Supplementing the scientific mixing of poison-grain baits has been the large-scale manufacture of pocket-gopher probes developed at the Control Methods Research Laboratory in conjunction with district agents of the Bureau. These probes have been standardized in two types, so that they will generally serve the requirements of all districts. Automobile trailers for field use in transporting bait and equipment also have been made up in the work shop of the bait-mixing station. The development of a warehouse for storage of field equipment for the Division of Game Management is rapidly becoming another of the major features of this station, and it is planned later to store standard field equipment at Pocatello to prevent delays in supplying material requisitioned by field men.

#### CONTROL METHODS RESEARCH

An important aid to field agents engaged in the control of injurious mammal pests is the laboratory maintained at Denver, Colo., to carry on research in improved methods. Rodents and predators living in close relationship with human activities develop resistance to methods of control when these are used for a period of years. Constant study is required to perfect improved methods, in order that the operational forces may keep injurious mammals within reasonable bounds.



The Control Methods Research Laboratory during the year carried on special studies for the control of field mice in Virginia. Orchardists in the Eastern States have experienced considerable difficulty in several localities after using strychnine-treated grains over a period of years. Based on the new studies, a change in baits will probably be recommended for those areas where control has proved exceptionally difficult.

Studies also have been carried on in the laboratory looking toward the development of successful repellents to prevent damage to seedlings by rabbits, mice, and ground squirrels. Of special aid in reforestation projects is the progress that has been made in perfecting a poisoned spray for treating seedlings before transplanting from seed beds.

Progress also has been made in the development of a fumigant for use in burrows of prairie dogs and ground squirrels. The Bureau has studied this problem for several years in an attempt to develop a cheaper and more effective fumigant.

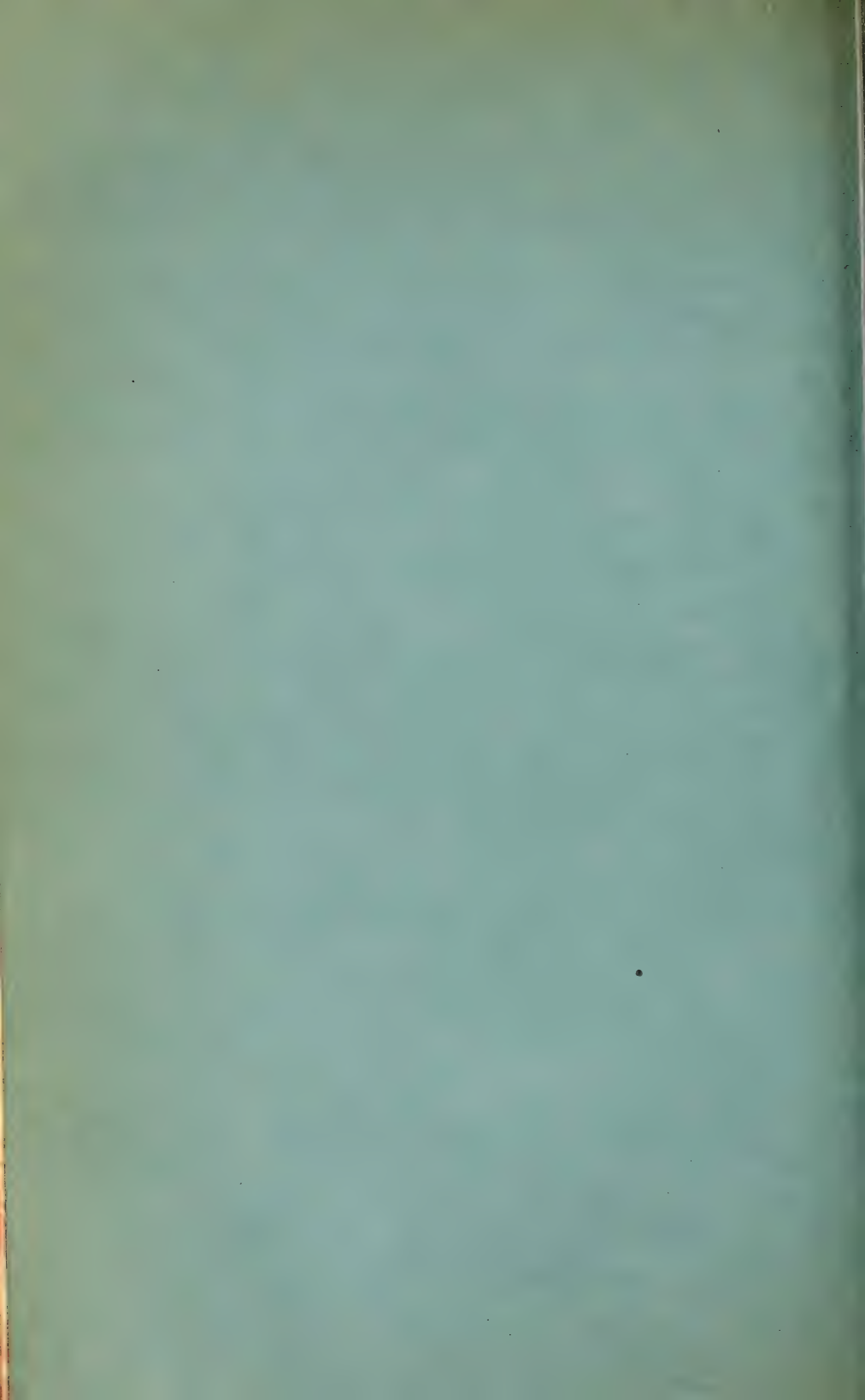
The laboratory is conducting an interesting study of coyote migration, to learn the effects of this habit on stockraising and on control methods. Of 9 coyotes tagged and released in January 1931, returns from 4 have thus far been received. During the first half year 2 were caught within 5 miles of the point of release. At the end of the first year 1 was trapped approximately 100 miles north, it apparently having been following along the range of mountains, as there had been no general movement of stock through this section that might have influenced its direction. The fourth coyote was taken recently within 5 miles of the point where released 4 years previously. More extensive tests are being made in other localities to gather additional information on the migrations of these predators.

Information on control issued during the year included two mimeographed leaflets of the Bureau, one (BS-7) giving instructions for controlling bats, the other (BS-10) on secondary poisoning from thallium used in rodent control.











# REPORT OF THE CHIEF OF THE BUREAU OF CHEMISTRY AND SOILS, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY AND SOILS,  
*Washington, D. C., August 31, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Chemistry and Soils for the fiscal year ended June 30, 1935.

Sincerely yours,

HENRY G. KNIGHT, *Chief.*

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## INTRODUCTION

The function of the Bureau of Chemistry and Soils is to apply chemistry and other natural sciences to the solution of problems connected with the production and profitable utilization of agricultural commodities. The solution of these problems benefits agriculture primarily, but also benefits the entire Nation, indirectly, since the products of the soil are used for food, clothing, and shelter, the three prime necessities of human life for which man must labor. The work is directed toward the conservation and profitable utilization of the soil, the acquisition and dissemination of knowledge concerning the distribution of soils of different types and the suitability of various soils for particular uses, a study of the fundamental factors concerned with the maintenance of soil productivity, the prevention of deterioration and loss of agricultural products and property, and the economic utilization of agricultural products and byproducts, by the application of the natural sciences to the technology of their preservation and conservation.

Most of the work is of research character with definite objectives intended to solve or assist in solving specific and urgent problems relating to soils, and the utilization of soil products, which have a direct bearing on the stabilization and prosperity of American agriculture. The activities for each year are definitely planned in advance and are divided into projects and subprojects for which funds are allotted from the annual appropriation for their support.

During the past year the Bureau's research work included investigations along the following lines: Soils and peats; nitrogen, potash, and phosphate fertilizer materials and their sources; concentrated mixed fertilizers; nitrogen fixation by living organisms; composition of foods; microbiology of foods; food deterioration and spoilage; food preservation and utilization; toxic effects of possible food contaminants; plant pigments; the nature of enzyme action; chemistry and nutritional value of proteins and vitamins; microbiology, preservation and utilization of hides and skins; sources of tanning materials; composition and properties of vegetable oils; chemistry of lignin; fermentation methods for the production of lactic and gluconic acids from sugars; utilization of wastes from crops and industries using farm products; prevention of farm fires and dust explosions; composition and properties of turpentines, rosins, and pine gum; and improvements in the technic of producing fertilizers, feeds, sugars, starches, sirups, proteins, tanning materials, turpentine, rosin, and fruit products.

In large measure the work of the Bureau requires the practical application of scientific knowledge, particularly a knowledge of chemistry in its broadest

sense, and other sciences involved in the study of soils, fertilizers, and agricultural materials. When there is a lack of fundamental knowledge needed to attack a specific problem, such knowledge must first be acquired through research in pure science. The results of such research contribute to the advancement of science in general and may have applications in fields other than agriculture.

Obviously scientific facts and principles already known should be put to useful purposes in farming, in utilizing the products of the farm, in the production of fertilizers, and in the industrial utilization of agricultural products. Usually the practical application of such knowledge comes many years after its development and dissemination. As needs arise, however, informed and progressive individuals in agriculture and in industries manufacturing fertilizers or using agricultural products may be depended on to make useful application of existing and available scientific knowledge and to pioneer in new or improved practices. The Bureau of Chemistry and Soils, therefore, is continually striving to give more of its attention to basic or fundamental research to develop new scientific facts and principles relating to soils, fertilizers, plant and animal nutrition, the elaboration of chemical substances by plants and animals, and the chemical composition and properties of agricultural products, which facts and principles may be applied by those engaged in agriculture or industries based on agriculture.

#### BASIC RESEARCH ON SOILS

Much of the investigational work in the chemistry and physics of soils, incidental to soil classification and the study of soil erosion, is of fundamental importance. During the past year it was found that certain soils contain, to varying degrees, selenium, arsenic, cobalt, nickel, zinc, copper, chromium, vanadium, and barium, and it appears that these trace elements may play an important role in soil behavior. Work on the detailed chemical composition of typically representative profiles of the great soil groups has shown that the composition of the active component of the soil, the colloid, is characteristic for each group. Soils and colloids of the semiarid areas were found to owe their characteristic differences primarily to the parent material. This is in sharp contradiction to the results previously found for humid soils. A study of the base-exchange capacity, neutralization curves, and the maximum acids shown by the colloids of the great soil groups is expected to yield a scientific explanation for the differences in the deterioration of soils by use. Studies are also under way on the effects of different climatic conditions on soils derived from the same parent material. An investigation of the causes of infertility in a group of soils derived from serpentine showed that in addition to having unfavorable physical characteristics, these soils contained large quantities of magnesium, chromium, and nickel, any or all of which may contribute to their low productivity.

#### BASIC RESEARCH ON FERTILIZERS

In the fertilizer investigations studies were made by physico-chemical methods of the factors which influence and determine the activities of catalysts in the various steps of processes for converting atmospheric nitrogen into nitrogenous fertilizer materials. In the synthesis of ammonia from nitrogen and hydrogen the two gases do not combine under any known conditions of temperature or pressure unless certain substances are present, which bring about chemical reaction on their surfaces. These substances are called catalysts. The success of the process depends upon effective and continuous functioning of the catalyst. A fundamental understanding of catalytic phenomena is useful in devising improved catalysts and catalytic procedures for the production of nitrogenous fertilizer materials. It will also be useful in other processes, not related to agriculture, where catalytic reactions are involved.

It was discovered during the past year that the isotherms of a number of gases near their boiling points bear a certain relationship to the amount of gas necessary to form a monomolecular layer on the catalyst surface. This fact furnishes an apparent means for estimating the surface area of synthetic ammonia catalysts. By decomposing ammonia on promoted iron catalysts it was found that the rate of reaction between nitrogen and hydrogen depends upon the partial pressures of ammonia and hydrogen and upon temperature. In measuring the heat of vaporization of electrons from catalytic surfaces



by the photoelectrical method it was discovered that activated adsorbed gases have a pronounced effect in lowering the energy of the escaping electrons, which indicates that in one form of adsorption the dissolved gas approaches an ionized state, and helps to substantiate recent theories of surface reactions.

Other research work of a fundamental character included the determination of the solubility of helium gas in water at various temperatures and at pressures ranging up to 1,000 atmospheres and the solubility of a 3:1 hydrogen-nitrogen mixture in water at 25°C. under pressures ranging from 50 to 1,000 atmospheres. Data were obtained which contribute toward a better understanding of the nature of the solution of gases in liquids.

Measurements were made of the vapor pressures of phosphorus pentoxide at temperatures ranging from 200° to 600° C. with specially constructed apparatus capable of measuring vapor pressures at temperatures up to 1,000°.

The crystallographic and optical constants of various acid phosphates and their hydrates, in pure form, were measured by X-ray diffraction analysis. An X-ray study of a number of oxalates, selected as representative organic compounds, showed a correlation of the shape and orientation of the oxalate group in the crystals with the optical properties of oxalates in general. The use of electron diffraction as a method of analysis disclosed that the phosphorus molecule in the gas phase at 200° C. is a regular tetrahedron.

In work upon the absorption of light by nitrogen trioxide gas a band spectrum due to nitrous acid was discovered, which furnishes a means for determining this substance in gaseous systems. The effect of pressure upon the absorption spectrum of nitric oxide was studied and a theoretical explanation was deduced. Infrared absorption coefficients were determined for more than 50 organic compounds containing the groups  $\text{NH}_2$ ,  $\text{NH}$ , and  $\text{OH}$ . The results are particularly important because they provide a method of quantitative analysis of these groups in molecules that are soluble in nonpolar solvents.

By use of the mass spectrograph it was found that the atomic weights of lithium, potassium, and rubidium can be determined with an accuracy far greater than by chemical means. Certain plant and animal tissues were found to have a pronounced ability to concentrate the heavier radioactive isotope of potassium. Studies will be made to determine the physiological significance of this preferential selection of one potassium isotope over another.

In a study of the production of nitrogenous compounds by the organism, *Azotobacter*, it was found that nitrogen fixation is probably a reduction rather than an oxidation process, and that the ammonia production reported by previous investigators must have been derived from cell nitrogen and not by direct synthesis from nitrogen gas as was supposed. Various intracellular enzymes, which may be instrumental in the production of nitrogen compounds by *Azotobacter*, were identified and a number of the intermediate compounds formed in ammonification were determined. It was found that the recently discovered accessory substance which is essential for the respiration and growth of certain species of organisms in legume nodules has many properties in common with pantothenic acid, but is not identical with it. Studies on leguminous plants indicated that the greater part of energy supply is not consumed in the chemical process of nitrogen fixation, as is commonly believed, but is utilized chiefly for the respiration and growth of the bacteria and host.

A nitrogenated compound was obtained by the reaction of active nitrogen with diphenyl acetylene. This is the first time that the possibility of such nitrogen reacting with organic substances has been demonstrated and the first case in which nitrogen has been fixed directly by an organic compound apart from living processes. The reaction has little practical significance but serves as a foundation for anticipating the introduction of nitrogen of a much lower energy content into organic compounds.

The use of modern physical and physicochemical research methods in the furtherance of fertilizer investigations constitutes pioneer work and will assist scientific investigators in the solution of numerous problems which depend upon a knowledge of the physical constants and ultimate structure of the elementary substances and compounds involved.

#### BASIC RESEARCH ON AGRICULTURAL PRODUCTS

Much of the research on the chemistry and technology of agricultural products is also fundamental. New knowledge gained from the study of the nature of enzyme action will be useful in many fields. Enzymes are organic substances of unknown chemical constitution contained within the living cell which are able to bring about chemical changes in plant and animal tissues

They are responsible for all the changes of ripening, curing, digestion, and decay, including food spoilage and fermentation. With an adequate knowledge of enzyme chemistry the course of chemical changes in plant and animal products may be predicted and possibly controlled. During the past year studies were made on the action of four different enzymes including the protein-digesting enzyme of wheat flour and the enzymes taking part in the spoilage of eggs, the darkening of fruits on drying, and the heating and decomposition of moist alfalfa hay. The wheat enzyme separated from bran was obtained for the first time in solution and was identified as belonging to the class of enzymes represented by papain.

Another research of fundamental character is that on plant pigments, which is a comparatively new field. Work outside of the Department showed a few years ago that some of the yellow plant pigments are the precursors or parent substances of vitamin A. It is likely that other plant pigments contribute toward the nutritional value of the foods in which they occur. Plant pigments are also important in that they affect the salability of fruits and vegetables, and food products prepared from them. The Bureau's work on plant pigments during the past year was concerned mostly with the coloring matters of apples and corn. The yellow pigment occurring in Grimes Golden and Jonathan apples was isolated and identified as a new and previously unreported galactoside of the flavonol, quercetin. Chrysanthemin chloride, an anthocyanin coloring matter, was isolated in pure form from purple-husked corn. Comparative studies on the pigments from brown-husked and purple-husked types of corn have indicated the possibility of a conversion in the plant of the flavonols (yellow pigments) to anthocyanidins (red pigments) by reduction of their corresponding homologous glucosides. Similar indications were observed in the study of red and yellow coloring matter in apples. This relationship, if definitely proved, constitutes a new and important discovery in connection with plant pigments. The work on corn pigments is of interest and value in connection with corn-breeding experiments.

Additional knowledge was gained during the year on the chemical components of the cuticle waxes of fruits. Oleic acid and the hydrocarbon, *n*-nonocosane, were found to be the predominant compounds of their respective classes in pear wax. Ursolic acid, previously found in apple and cranberry waxes, is also present in pear wax.

Studies on yeast proteins yielded more definite information concerning the actual quantity of proteins in yeast and the amino acid content of yeast proteins. An investigation on wheat containing the toxic element, selenium, showed that the selenium is present in an organic form intimately associated or combined with the protein. Most of the selenium could be concentrated in the leucine and tyrosine fractions of the hydrolysis products of the wheat gluten. An improved method was devised for determining the amino acids in wheat flour. A popular brand of commercial wheat flour was found to contain 0.31 percent cystine, 0.16 percent tryptophane, and 0.22 percent lysine, which shows that the protein of wheat flour compares more favorably with other proteins, as regards the nutritional value of its amino acids, than is generally appreciated.

Studies on the value of alpha- and beta-carotene as sources of vitamin A showed that alpha-carotene has about 56 percent of the potency of beta-carotene. The laboratory findings lend support to the view that gamma-carotene and cryptoxanthin, which also serve as sources of vitamin A, are only one-half as valuable as beta-carotene. These results have an important bearing on attempts to establish vitamin A potency of plant products by chemical and physical methods.

In the work on industrial fermentations a species of mold was found which will give high yields of dextro-lactic acid as a result of its action on glucose. This discovery is of fundamental significance because it is the first time that dextro-lactic acid, which differs in its properties from the usual kind of lactic acid, has been produced in appreciable quantity outside of a living animal body, where it exists as a constituent of muscular tissue. This form of lactic acid may prove to have industrial and medicinal uses.

Progress is being made in the research on lignin, one of the three principal constituents of plant materials. While the ultimate purpose of this investigation is to develop uses for the immense quantities of lignin annually going to waste with crop byproducts, the work on its chemical structure and derivatives, which is an essential prerequisite to the practical utilization of lignin in chemical industries, is of interest to science in general.



Fundamental studies are being made on the microbiology of hides and skins to develop knowledge required for the very practical purpose of preventing hide damages and serious losses in leathermaking from the action of micro-organisms during cure, or temporary preservation, prior to tanning. During the past year further attention was given to the organism causing the flesh reddening of salted hides. The organism was isolated and tentatively identified. A stage of growth of this organism with which no well-defined stainable bacterial cells could be associated was observed for the first time, as was also its great variation in cell types, or appearance, depending on the nutrients upon which it grows. This observation helps to explain the origin of much confusion in this field of work which is of interest in connection with the salting of fish, meats, and other food products, as well as in the curing of hides and skins.

Another example of fundamental research with practical value to agriculture as the ultimate goal is the study of the chemical components of pine gum, rosin, and the various kinds of turpentine obtained from southern yellow pines. Work is in progress on the separation and identification of the chemical components of steam-distilled wood turpentine, which contains approximately 20 compounds, including terpene and aromatic hydrocarbons, aldehydes, secondary and tertiary alcohols, phenols, oxides, and phenol ethers. More complete knowledge regarding the minor constituents of various kinds of turpentine is useful in distinguishing one kind from another and also in connection with the development of new uses for turpentines and the suitability or adaptability of different turpentines for specific uses.

The examples cited show that the work of the Bureau of Chemistry and Soils, although designed to be of practical service to agriculture, nevertheless contributes materially to the advancement of science. More detailed information regarding the investigations mentioned is given in the body of this report, together with the results of other activities.

## CHEMICAL AND TECHNOLOGICAL RESEARCH

### CARBOHYDRATE INVESTIGATIONS

#### SUGARCANE

A proper evaluation of the new varieties of sugarcane, which have recently been developed, requires a knowledge of the "working quality" of the juices in the sugar factory, as well as information regarding cultural requirements and disease-resistance characteristics.

During the 1934 cane-harvesting season additional studies were made on the sulphur-lime and the tannin-lime methods of clarification when applied to juices from new varieties of cane. Particular attention was directed toward the effects of the clarification process upon the chemical composition of the juice, concentrated sirup, and crystallized sugar, upon certain physical characteristics of the sirup and sugar, and upon the yield of crystallizable sugar. Preliminary data were obtained on the volume and weight of "mud" separated by the different clarification methods.

Examination of the results of the clarification studies during the past 3 years is under way, and a comprehensive report will be made comparing the various modifications of the methods which have been used.

The studies pertaining to the effect of cultural conditions on the composition and workability of different varieties of sugarcane were continued at the Houma, La., station in cooperation with the Soil Fertility Division and the Division of Sugar Plant Investigations of the Bureau of Plant Industry. The samples of cane were from test plots, which represented various soil types and fertilizer treatments, located in different sections of the sugarcane belt. Particular attention was given to the two newly released varieties, C. P. 28/19 and C. P. 28/11. From the chemical standpoint the juices of these two varieties are strikingly different, for C. P. 28/19 is low in ash, being nearly on a par with the P. O. J. varieties, with which they were compared and which have previously been studied, while C. P. 28/11 is decidedly higher in ash than any variety thus far examined. This higher ash content is principally due to increased quantities of potash, phosphate, and sulphate. The high ash content of juice from C. P. 28/11 resulted in increased quantity of ash in the sugar, but in other respects the sugar quality was average. The sugars from C. P. 28/19 were lower in ash and of better color.

The effect of soils on juice and sirup composition was seen to be greatest when comparing the southwestern portion of the Louisiana sugar belt with the southeastern portion. There were marked contrasts both in the quantity of ash and its composition, and also in the color of the sirups and sugars. The juice of cane from the former section was low in ash, yet comparatively high in lime and silica; the reverse was true for the southeastern section. These differences are in some cases more marked than is the contrast of the effects of so-called "sandy" and "black land" soil.

The investigation on the deterioration of harvested sugarcane was continued in cooperation with the Division of Sugar Plant Investigations. The primary object of this work is to ascertain how harvested sugarcane may be stored for fairly long periods with a minimum of deterioration in order that cane mills may have sufficient supplies for continuous operation and not be forced to shut down during wet weather when it is impossible to haul cane from the fields.

It was found previously that deterioration could be retarded by occasionally sprinkling the piles of harvested cane with water. This practice has been adopted by a few of the sugarcane plantations and it is believed it will expand as additional detailed information becomes available from further investigational work by this Department and as the growers become familiar with the method and the advantages of its adoption.

During the 1934 season particular attention was given to some of the fundamental phases of the problem, such as the influence of temperature, humidity, maturity, and varietal differences on the rate of deterioration. The findings substantiated those of previous seasons in that storage under dry conditions was conducive to deterioration. The best temperature for storing cane under moist conditions was about 65° F. More deterioration took place at 45° than at any higher temperature studied, the highest temperature being 75°. Of the four varieties of cane studied Co. 281 was the most resistant to deterioration; the others in descending order were Co. 290, C. P. 807, and C. P. 28/19. Cane harvested late in the season deteriorated at a slower rate than less mature cane.

Some attention was also given to the deterioration characteristics of a number of the new varieties of sugarcane being developed by the Bureau of Plant Industry for the purpose of aiding in their evaluation for commercial planting. These canes, after harvesting and stripping as for milling, were stored in small piles under shelter and were also windrowed in unstripped condition in accordance with the usual practice. None of the varieties tested was as resistant toward deterioration as was Co. 281, which was used as a standard.

It was found that the invertase content of sugarcane increased with the time of storage and to a somewhat greater degree under dry than under moist storage conditions. It was also found that, roughly, the invertase content of the fresh cane was proportionate to the susceptibility of the different varieties of cane to deterioration. Although Co. 281 deteriorates very slowly, even under adverse storage conditions, it contains sufficient invertase to cause a very much higher degree of inversion than ever takes place. The factors which control the reaction between the invertase and the sucrose in the live plant are unknown. Analyses of the nodes and internodes for sucrose and reducing sugars revealed the fact that inversion takes place at approximately the same rate in both types of tissue in spite of the much higher concentration of invertase in the nodes.

#### SUGARCANE SIRUP

The greatest need of the farmers who produce sugarcane sirup as a cash crop continues to be an improvement in the quality and uniformity of their product in order to meet market requirements to the best advantage. The many requests for information on practical farm methods for the production of sirup of more uniform and higher quality have been met by the dissemination of circulars on the subject and by demonstration work in the field. In cooperation with the east-Texas branch of the Texas Agricultural Experiment Station, the sirup-making qualities of six of the newer varieties of sugarcane were compared by use of the Department's standard small-scale method of sirup making. Demonstrations of farm-scale sirup making, including the use of invertase to prevent crystallization, were given in Texas and Mississippi. During the past few years sirup makers in Mississippi have been growing increasing quantities of the newer varieties of sugarcane. These new canes are not only better tonnage producers and more resistant to disease, but are also richer in crystallizable sugar than are the older varieties. Sirup makers are rapidly learning that they



now need to use the invertase process, whereas a few years ago with the older varieties of cane the use of invertase was not so frequently necessary.

In cooperation with the Division of Sugar Plant Investigations, about 50 samples of table sirup were made from several of the newer varieties of sugarcane at the Houma, La., Experiment Station. This investigation of the sirup-making qualities of the new canes is of considerable commercial importance, and supplements the determination of cultural requirements, and tonnage and sirup yields, as a means for deciding what varieties are best for commercial cultivation.

#### SORGO SIRUP

Sorgo sirup as produced on many farms in the United States is decidedly nonuniform in quality. This defect has been a serious handicap to farmers in obtaining the fullest profit from this important cash crop. Investigations were continued for the purpose of devising means whereby sorgo sirup of more uniform and improved quality may be made directly on the farm. The new methods which have been previously reported were studied further in order to adapt them in the most practical and efficient manner to farm-scale operation. Considerable attention was also given to the effect of variety and cultural conditions on the quality of sirup produced by a standardized method.

One of the principal difficulties experienced by sorgo sirup producers is slow boiling, which often results in scorching the sirup. This trouble was found to be caused by the presence of starch in the juice, which in addition to retarding evaporation will, if present in large quantity, cause actual jellying of the sirup. The use of a high diastatic malt for hydrolyzing the starch is recommended to overcome this difficulty. It was found that the greatest benefit from the use of malt is obtained by applying it after the juice has been evaporated to a semisirup. The usefulness of the diastase method for preventing slow boiling, scorching, and jellying of sorgo sirup was demonstrated in cooperative work with the Arkansas Agricultural Experiment Station. The drought of 1934 apparently was responsible for the fact that it was practically impossible to produce sirup of satisfactory quality by the usual farm methods. By employing the newly developed improved method, sirup of excellent quality was produced from the same sorgo cane.

In a further study of the quality of sirups made from different portions of the stalk it was found that considerable improvement in the quality of sirup could be obtained by utilizing only certain portions of the stalk. Whether this will prove to be a practical aid has not yet been fully determined.

Demonstrations of the new methods for sirup making were made in Texas, Arkansas, and Mississippi at the request of the respective State directors of extension. Cooperative agreements between the Bureau of Chemistry and Soils and the State agricultural experiment stations at Starkville, Miss., and Fayetteville, Ark., were entered into for the purpose of conducting research on the suitability of different varieties of sorgo for sirup production, particularly when considered in relation to soil types, fertilizer treatment, and climatic conditions.

#### HONEY

Further work was done on a new method of processing extracted honey and a description of the method was published in a number of trade journals. The new method, as finally developed, is based upon the filtration of honey at its original density mixed with a small proportion of diatomaceous earth having rapid filtering quality, preceded by rapid heating and followed by rapid cooling. The resulting product is brilliantly clear, and there is no tendency to form surface foam or scum. The color, flavor, and aroma of the honey are not changed. Granulation is retarded, which is an important factor in the marketing of extracted honey. The development represents a decided improvement over existing methods of processing honey, which do not reduce turbidity to any appreciable extent, which cause an appreciable loss of aroma and flavor, and which are likely to result in the formation of scum on the surface and, usually, in some darkening of color due to long heat treatment.

In cooperation with a commercial firm about 1 ton of extracted honey was processed by the improved filtration method for the purpose of trying out the method thoroughly and to make available material for further large-scale and laboratory tests.

Laboratory tests on samples of honey processed by the improved filtration method showed that sensitive constituents, such as enzymes, were unaffected

by this method of processing. This is in contrast to results obtained by the usual methods of processing in which the diastase and other enzymes are greatly weakened in activity, and in some cases entirely destroyed. The mineral content of the honey was unchanged. Changes in density were in most cases too small to be measurable by the usual methods. Color and flavor were unchanged. The number of colonies of yeasts which could be developed from the filtered honey was only a fraction of the number which could be developed from the unprocessed honey. This characteristic may be important as a means of combating fermentation in honey without resort to drastic heat treatment, which usually results in injury to the color and flavor of the honey.

Work was continued on the development of a small processing plant suitable for the honey producer. Certain parts of the equipment were built and tested to insure proper working, and drawings of a small-plant design were made for publication.

#### SUGAR BEETS

Certain food industries in the areas of beet-sugar production have not been inclined to use beet sugar for all their sugar requirements because of nonuniformity in quality. This is a serious drawback to the economical distribution of this important agricultural product and materially reduces the price obtained by sugar-beet growers. As an aid in combating this situation investigations have been continued to determine the identity of those non-sugar constituents of the sugar beet which have an adverse effect upon the quality of sugar and means for reducing or eliminating these constituents. Further study was also made of the analytical methods employed in the examination of the samples of sugar and other products.

As a result of the research work by the Bureau of Chemistry and Soils, commercial beet sugar has become more uniform in character, and its quality has improved progressively during the past few years. The improvement in quality is indicated by the yearly average values for the ash content of beet sugars analyzed since 1929. In that year the average value for ash content was 0.043 percent. There has been a decrease in the average value for ash content each year, and in 1934 it was only 0.014 percent. Samples submitted by 18 of the 52 cooperating factories during the 1934 beet-sugar season showed an ash content of 0.01 percent or less, while in 1933 there were only 5 of 53 factories in this class. Complete analytical data on these sugars, including screening tests, in correlation with the factory operating data, are being prepared for publication.

#### UTILIZATION OF CULL SWEETPOTATOES FOR STARCH

The starch content of sweetpotatoes determines their intrinsic value from the standpoint of industrial utilization. A survey previously made by the Bureau showed that there is a potential market for root starches in the United States to replace imported potato and cassava starches. In previous reports it was shown that sweetpotato starch is suitable for the sizing of warp yarns, for finishing cotton fabrics, for laundry use, for conversion into dextrin to be used for adhesives, and for paper sizing.

As a step toward establishing a sweetpotato-starch industry in the United States, the Federal Emergency Relief Administration allocated funds to the Mississippi Emergency Relief Administration for the manufacture of starch and byproduct pulp by the process developed in the Bureau of Chemistry and Soils. The Bureau provided the technical, chemical, and engineering direction and supervision necessary for the purchase, installation, and operation of the equipment, conducted such plant research as was required to insure successful operation of the factory, and acted in a directing capacity in the disposal of the finished products and byproducts. The Mississippi Agricultural Experiment Station acquired the title of the factory equipment and properties and leased them to Sweet Potato Growers, Inc., a cooperative agency organized under the Mississippi State cooperative laws for operation of the plant.

During the summer and early fall of 1934 starchmaking equipment necessary for processing 60 tons of sweetpotatoes per 24 hours was selected and installed as well as a laboratory and experimental plant. The latter were put in operation about October 10, and the factory proper about November 10. During the operation of the plant detailed tests were conducted to determine the



capacity and efficiency of the various pieces of equipment. The plant ceased operations on December 29.

From the result of the first season's operation and further study of the project, a number of changes, both in the chemical treatment and mechanical equipment, are being made which should place the plant on a wholly satisfactory operating basis.

About 70 tons of starch were produced, most of which was purchased by a local cotton mill for use in sizing warp yarn. Feeding tests conducted by the Mississippi station, using sweetpotato pulp, a byproduct of the starch factory, showed it to be a highly satisfactory feed for milk cattle and for fattening beef cattle when used as a substitute for corn in certain mixed feeds. Dextrin prepared from sweetpotato starch produced in the Laurel plant was submitted to the Bureau of Engraving and Printing, which reported it to be suitable for postage-stamp adhesive.

#### CARBOHYDRATES IN DOMESTIC PLANTS

The investigation on the utilization of chicory roots as a source of inulin and of levulose sirup was continued.

There is a definite market for levulose sirup of good color and clarity and a high degree of sweetness, because it is noncrystallizable under ordinary conditions of use and promotes retention of moisture when used in food and other products. Levulose sirup from chicory gives promise of utilizing an agricultural crop which now is grown only to a limited extent, but could be easily expanded.

Particular attention was given to the production of a suitable grade of levulose sirup on a semicommercial scale and to overcoming some of the difficulties previously encountered. Several improvements of a chemical and mechanical nature were introduced, which resulted in the production of a very satisfactory sirup of light amber color and neutral flavor. Further study is being made for the purpose of lowering, if possible, the cost of producing levulose sirup from chicory and of finding means of utilizing profitably the extracted pulp.

Cooperative work on the value of inulin from a medical and dietetic standpoint was continued in cooperation with medical specialists, and a fundamental study on the hydrolysis of inulin was begun.

#### FOOD-RESEARCH INVESTIGATIONS

##### ENZYME STUDIES

A continuation of the study of trypsin in egg white has confirmed the opinion expressed in the last annual report that spoilage of eggs in storage is due to the activity of this enzyme. Such spoilage results in a loss of millions of dollars annually. Carefully controlled experiments have shown that the amount of active enzyme decreases as the hydrolysis of the thick white progresses, while at the same time the alkalinity rises to a maximum and then drops back. The same trend was shown by stored eggs treated by the vacuum oiling process developed in this Bureau and previously reported. Changes were in smaller degree, and the difference was so marked as to show very clearly that the oiling process slows down the proteolytic cleavage of the egg white which causes the spoilage.

Based on this work an improvement in the commercial manufacture of dried egg albumen has been devised. Trial runs demonstrated that by the use of the specified enzyme treatment the processing time can be reduced to 2 days as against the usual  $7\frac{1}{2}$  days; the quality is better, as shown by the usual trade laboratory tests; and the sanitary condition of the product is markedly improved, as evidenced by a bacterial count of about one-sixth of that to be expected from material treated by the usual commercial methods.

Owing to cost of production the domestic egg-drying industry has been unable to make much headway in competing with the imported product. It is hoped that the advantages of this new process, on which a patent dedicated to public use is being secured, will enable the industry to operate with profit to themselves which should be reflected back in profits of egg producers.

Work on the enzymes encountered in breadmaking showed that the protein-digesting enzymes of flour interfere with the production of high-quality com-

mercial bread. These undesirable enzymes were known to exist but had never been measured, isolated, or identified.

Coarser flours containing more of the outer tissues of the wheat were found to contain more of the enzymes. Wheat germ and bran are particularly rich sources. The enzyme was finally separated from the bran, obtained for the first time in solution, and identified as belonging to the class of enzymes represented by papain.

The effect of this enzyme solution upon the process of commercial bread-making was found to be very unfavorable. The beneficial effects due to bleaching or aging flour, or adding oxidizing agents such as persulphate to the dough, are mainly the results of the destruction of this proteinase.

The work on dried fruit darkening has been continued. It was found in the practical handling of evaporated apples that in order to obtain the best results in the prevention of discoloration care is necessary to prevent contamination with heavy metals. Nickel and copper are apparently worse than iron; hence stainless-steel equipment is preferable to monel metal in commercial drying plants.

A series of experiments on the decomposition of alfalfa in oxygen, in nitrogen, and in carbon dioxide was conducted. While the decomposition is due to enzymic change, the causative enzymes are found both in the plant itself and in the micro-organisms contaminating it. These two factors were not evaluated separately. The thermal effects, as was to be expected, were marked only in oxygen and air. Sugar decomposition occurred also in nitrogen, the aerobic decomposition apparently differing from the anaerobic, which is probably a type of fermentation. Carbon dioxide inhibited this fermentation, presumably by affording an overwhelming concentration of one of the reaction products. Moist alfalfa was kept in an atmosphere of carbon dioxide for periods as long as 5 weeks without spontaneous heating or visible signs of putrefaction, and with very little loss in sugar. Similar samples kept in oxygen or in nitrogen decayed badly.

#### PHYTOCHEMICAL INVESTIGATIONS

Work on the isolation and identification of component constituents of the cuticle waxes of various fruits, principally of the pear and grapefruit, has been continued during the past fiscal year. The predominant fatty acid isolated from pear wax was oleic, and the predominant hydrocarbon was *n*-nonacosane. Ursolic acid, previously reported in apple and cranberry waxes, was also present in pear wax. These waxy coatings, now studied in the apple, pear, cranberry, and grape, are important factors in the adherence of insecticidal dusts and sprays and their subsequent removal. Some of their chemical constituents offer promise of commercial use in protective coatings such as lacquers, or as emulsifiers in certain food products. The raw materials from which they may be obtained are available in large quantities in the cannery wastes which accumulate every year and constitute an acute problem in economic and sanitary disposal.

Investigations of the composition of grapefruit wax, which forms 7 to 8 percent of Florida grapefruit-peel oil obtained by pressing the peel between rolls, was begun during the past year. Although the work is not yet complete, the wax appears to be unlike any previous waxy coating investigated. From the standpoint of both the number and the nature of its constituents it appears to be quite complex.

#### PLANT PIGMENTS

The study of plant pigments has been continued, with particular emphasis on the coloring matters of apples and corn. The yellow pigment occurring in Grimes Golden and Jonathan apples has been completely identified as a new and previously unreported galactoside of the flavonol quercetin. The anthocyanin or red pigment occurring in Jonathan and Stayman Winesap apples has been isolated and identified as idaein, a galactoside of cyanidin which has previously been reported from other sources.

We have in the case of apples another instance where the anthocyanin corresponds to the flavonol in being its reduction product. A similar relation between the pigments of corn husks is the only other case where a correspondence has been shown between the glucoside of an anthocyanidin and of a flavonol. In view of the importance of color in apples to both grower and consumer it is a step forward to know definitely the exact value of the pigments involved.



Progress has previously been reported on the isolation and crystallization of the purple pigment of purple-husked maize, one of a series of color types whose heritable behavior has been determined by R. A. Emerson at Cornell University. One phase of the corn-pigment work has now been brought to a successful conclusion. Chrysanthemin chloride, an anthocyanin coloring matter, was isolated in pure form and identified as such from purple-husked maize. The pigments have now been isolated from the brown-husked and purple-husked types. The evidence obtained thus far favors the possibility of a conversion in the plant of the flavonols (yellow) to anthocyanidins (red) by reduction of their corresponding homologous glucosides.

This work, besides being of interest and value from the standpoint of corn-breeding experiments, may prove to be of considerable importance in connection with results published by R. A. Brink, who has recently pointed out that anthocyanin pigments may have an economic value not heretofore suspected, since certain of these coloring substances in corn appear to be correlated with yield of ears. Should such a relationship be substantiated, the Bureau's work on the nature of corn pigments would form the basis for further extensive research in order to determine and evaluate the exact relationship between pigment content and yield of ears.

#### THE TOXICITY OF FLUORINE COMPOUNDS

The toxic action of fluorine ion on various enzymes is well established, and it has been shown in this Bureau that an active preparation of bone phosphatase exhibits a diminished hydrolytic action on sodium glycerophosphate in the presence of fluorine ion. Such an action suggests the possibility that fluorides have an effect on carbohydrate metabolism which involves the hexose phosphates and phosphate ion. Making use of the micro-organism *Glaucoma piriformis* it has been shown in this Bureau that fluorine inhibits glycolysis. This result is in agreement with the observation of K. Lohmann that the addition of fluoride to a muscle extract leads to the formation of a difficultly hydrolysable hexose diphosphoric acid ester.

Because of the ability of fluorine ion to inhibit phosphatase activity in the living animal, experiments were carried out in vitro in an effort to obtain a quantitative idea of the ability of fluorine ion to inhibit the hydrolytic action of a bone phosphatase preparation on sodium glycerophosphate. It was found that a definite degree of inhibition was present when the concentration of sodium fluoride was as low as one two-hundredths molar. Attempts to reverse this action by dialyzing out the fluoride have failed, although the liberated phosphate ion is freely dialysable under the same conditions.

#### SPOILAGE IN SIRUPS AND BEVERAGES MADE FROM WHITE SUGAR

Results of surveys carried on during the past year indicate that continued improvement is being shown in the biological quality of commercial sugars, due to the elimination of yeast stimulants and the reduction in numbers of spores of thermophilic bacteria of the food-spoilage type in the processes of sugar making and sugar refining.

Especially unsatisfactory conditions had been found in sugars collected from various domestic factories in previous seasons, in that excessive numbers of spores of thermophilic bacteria of the food-spoilage type were present, which would render the sugars unsuitable for commercial canning purposes according to established trade standards. On this account a careful study was made and at the close of a 14-week survey, during which 379 samples of finished sugar from 20 factories were examined, only 1 factory was found that was unable regularly to produce sugar that was suitable for cannery uses when production was controlled by methods previously suggested by the Bureau.

#### EGGS AND EGG PRODUCTS

The possibilities in the commercial oil treating of shell eggs by the vacuum carbon dioxide method have been further enlarged by demonstrating that oil at ordinary room temperature (60°-80° F.) may be used without the application of heat. This oil is a commercial product, developed especially for oiling eggs at room temperature. After 7 months in commercial storage, eggs graded by Department experts showed that this new application of the vacuum carbon

dioxide process is far superior to other oil treatments, in that eggs so treated graded between 55 and 32 percent higher than control lots both oiled and unoiled. Use of an oil of this type brings the vacuum carbon dioxide oiling method within reach of the egg producer, and indicates the possibility of more general usage of vacuum oiling on the farms where eggs are produced. This should result in a larger percentage of storage eggs of high grade with increased profit to the farmer and greater satisfaction to the consumer.

#### STUDIES ON WINE MAKING

The experimental lot of champagne bottled in 1933 in cooperation with the New York State Agricultural Experiment Station and wineries in the Finger Lakes section of New York has been opened and compared with commercially prepared champagne, the aim of the experiment being to study the value of various fermentable sugars in promoting the secondary fermentation in the bottle, and the role of our stock yeast cultures in developing characteristic flavors.

Results seem to indicate that cane, beet, corn, and invert sugars of high purity may be used with results equal to those obtained with rock candy, which is in general use. Preliminary examination has shown that not all yeasts listed as champagne yeasts gave desirable results. On the other hand, some of the still-wine yeasts showed very desirable characteristics for champagne making. These studies are being continued.

Pasteurizing experiments carried out in the laboratory and in commercial wineries indicate that New York State wines, both sweet and dry, which are normally low in alcohol content but high in acid, may be safely pasteurized at lower temperatures than those in common use, a holding temperature of 130° F. for 20 minutes providing an ample margin of safety when applied under controlled conditions. Lower pasteurizing temperatures mean less change in flavor and therefore a more acceptable product.

#### ORANGE AND GRAPEFRUIT JUICE INVESTIGATIONS

Shipments of deaerated and flash-pasteurized orange juice in bulk under refrigeration have been made in cooperation with Florida firms and individuals interested in this method of distribution. The juice was considered of satisfactory quality in every respect upon arrival in northern markets. This type of product is readily adaptable to distribution by dairies, as is a newly developed beverage concentrate suitable for making orangeade. If properly handled in the retail market such products should provide a growing market for cull and surplus fruit of high juice quality but not salable as fresh fruit.

Deaeration and pasteurization experiments have been carried out in canneries, and several commercial installations of equipment designed by this Bureau were in use during the past season in different citrus-producing sections. It is expected that other installations will follow during the coming season.

Experiments on canning Texas grapefruit have been tried, but owing to the inherent tenderness of the fruit it is difficult to keep the segments intact during processing. On this account it is probable that Texas grapefruit not of satisfactory grade for the fresh-fruit market will find an outlet in juice and beverage products.

Methods of preserving the flavor of concentrated grapefruit juice have been studied and formulas for the preparation of beverage concentrates have been developed.

#### ALCOHOLIC CITRUS BEVERAGES

Wine of excellent quality has been made from oranges, tangerines, and grapefruit. Citrus wines on naturally aging develop a sherry flavor. Grapefruit wine has a tendency to be bitter, but by proper selection of fruit and treatment with activated charcoal much of the bitterness is eliminated.

Refrigeration is necessary in the warm climate of citrus-growing regions to obtain a desirable fermentation temperature (60° F.). Experiments with carbonated wines have not given a satisfactory product, mainly because the natural sherry flavor in citrus wines is not satisfactory under carbonation.

Brandy was made, utilizing the waste juice from canneries. Part of this brandy was used in the preparation of citrus cordials.



## CITRUS OILS

Quite satisfactory yields of orange- and grapefruit-peel oils were obtained by means of a continuous screw press of special design. This oil did not differ in physical constants from oil obtained by a roller-pressing process already in commercial use. Concentrated citrus oils were prepared by vacuum evaporation of 80 percent of the limonene from the oils.

A ready market takes the entire output of orange oil, but it is essential that outlets be found for grapefruit-cannery waste. This byproduct is available in increasing amounts and is a potential source for oil, pectin, and naringin, the glucoside that gives grapefruit its characteristic, bitter flavor. Limited amounts of the waste are now being utilized for feeding purposes and as fertilizer.

## CHEMICAL COMPOSITION OF THE LOQUAT

The loquat, or Japanese medlar, is closely related to the apple, quince, and pear. It has been grown in the United States for at least 40 years but has not attained a large production, possibly because it requires essentially the same type of land and cultural and climatic conditions as the citrus fruits. The loquat has a pleasant, subacid flavor and may be used for jellies, jams, and pies, although it is largely consumed as fresh fruit. It appears on the southern markets when there is little fresh fruit other than citrus, and there is a large local consumption but not much wide-spread distribution.

A careful study has been made of the composition of the fruit, about which little has been known. A comparison of the loquat with the apple indicates that the apple is higher in total and soluble solids and total sugars and lower in water, total ash, and alkalinity of the ash, the difference naturally varying somewhat with variety. This type of data is of material assistance to nutritionists and dietitians and can be used to good advantage in popularizing food plants introduced into this country by the Department's Division of Plant Exploration and Introduction.

## PASSION FRUIT PRODUCTS

Although the passion fruit, which superficially resembles a large purple plum, is native of the tropical or subtropical Americas, its cultivation in the United States on a commercial scale is quite recent. The flavor of the fresh fruit has been likened to a combination of pineapple, guava, mango, apricot, and strawberry, but on account of the large number of small seeds, the sale of fresh fruit is limited, in spite of its delightful flavor and odor. Means have therefore been sought for utilizing the fruit in manufactured products of various kinds. A machine has been devised for separating the juice from the shell and seeds, and methods have been developed for preserving the juice by freezing, pasteurizing, and concentrating, and for making carbonated drinks, jellies, and sirups. Both wine and brandy have been prepared from the juice and have a fine, highly characteristic aroma, but have not sufficiently aged as yet to indicate their full possibilities as to flavor.

## LOOSENING THE HULLS OF WALNUTS

Preliminary work cited in the last annual report indicated that the use of ethylene in loosening the hulls of sticktight walnuts resulted in a larger proportion of high-quality shelled nuts, but that several problems connected with its use were still unsolved.

In continuing this work, five locations in California were selected representing the different climatic conditions under which walnuts are grown. In the coast section, where there is a natural tendency for the nuts to "vein", heavily veined kernels are classed as "ambers" and are not included in the highest grade. Since the ethylene treatment seems to accentuate this condition its use in the districts affected is being discouraged for the present.

The proportion of green sticktights is high in the early part of the harvesting season. If allowed to remain on the trees until the nuts can be hulled without treatment, the proportion of dark kernels, or ambers, increases. The ethylene process will be most valuable to the growers in localities, especially in the interior sections, where hot weather at the time of maturity delays the cracking and loosening of the hulls. Our work has demonstrated that there

is a proper time to begin the harvest and to delay it beyond that time results in serious loss from the development of dark kernels. No difference has been detected in the flavor of treated and nontreated nuts, and the first year's storage tests show no greater decline of color quality in the treated than in the untreated samples.

As a result of the work this past year, a number of walnut growers are erecting new plants for the treatment of nuts. A survey shows that there were 77 growers in Los Angeles County alone who used the ethylene treatment in last year's harvest. In a few instances where cost figures were kept, returns were increased by \$50 to \$100 per ton.

#### LIGHT AND RANCIDITY

In studying the rancidity-delaying properties of well-known antioxidants it has been found that the absence of light (afforded by an opaque or green wrapper) is more efficient in delaying the rancidity of oil than any of the antioxidants tested, with the possible exception of pyrogallol, which cannot, of course, be used in products for either human or animal consumption.

Experiments have shown that when rancidity results from exposure to sunlight it is not necessarily dependent upon the actual peroxide formation.

Experiments conducted with filters, chosen according to their ability to transmit light within certain limits indicate that oil thus exposed to light becomes rancid in every case except under green filters delimited by 4900-5800 Angstrom units and filters transmitting mainly infrared light.

#### STUDIES ON SOYBEANS

Soybeans of the Mammoth Yellow variety were used. Beans of both high- and low-moisture content were stored in various types of containers at temperatures ranging from  $-10^{\circ}$  to approximately  $+30^{\circ}$  C. Our analyses showed that in general the lecithin content was greatest in beans of low-moisture content which had been stored at a low temperature and decreased as the temperature of storage and/or the moisture content increased. Such differences are important to growers of soybeans and manufacturers of lecithin and other soybean products. This work was done in collaboration with the Bureau of Plant Industry.

#### SPECIAL BREADS

A greater consumption of wheat flour in this country might result if well-risen, appetizing special breads with an appeal to those who now eat little or no bread were given greater prominence and publicity.

Well-risen, high-protein breads of good flavor have been made with combinations of gluten flour or gum gluten and soybean flour and with the further addition of inulin. Other special breads of very good quality have been made by using varying amounts of soybean flour in the usual baker's formulas for bread. A novelty bread is an entirely new type of yeastless bread raised by means of hydrogen peroxide of the grade known commercially as 100 volume or 30 percent. Since this peroxide bread, while of very good appearance, is lacking in flavor, the use of cheese or other highly flavored ingredients has been found to increase the appetite appeal.

Both yeast and peroxide breads were analyzed and it was found that while the percentage of fat, ash, and total nitrogen were the same, the peroxide bread contained approximately three times as much sugar, alcohol-soluble nitrogen, potassium-sulphate soluble nitrogen, salt-soluble nitrogen, and water-soluble nitrogen. This comparison of the composition of yeast-leavened bread with bread raised by means of hydrogen peroxide gives additional insight into the changes that take place when flour is converted into bread as the result of yeast fermentation.

#### STALING OF BAKERY PRODUCTS

The use of commercial canned pineapple juice in baking seems to retard staling to some extent, and baking tests with certain fat emulsions have also given results which appear quite encouraging.

Analyses of bread that had been stored at  $-10^{\circ}$  C. for 1 year showed that, in comparison with fresh bread from the same baking, the composition was practically the same except that the fresh bread contained four times as much



soluble starch as the stored bread. This corroborates the statement of J. R. Katz that the process of staling is accompanied by a decrease in the soluble-starch content of bread.

## INDUSTRIAL FARM PRODUCTS DIVISION

### HIDES AND SKINS

Better cured hides and skins are desired by all producers, packers, and tanners. They are worth more and bring the farmer greater returns because they yield more and better leather. First-quality leather can be made only from sound, well-preserved hides and skins.

Salt, which has been used so long and so extensively for curing hides and skins, is not a perfect preservative. Certain bacteria and molds can live and grow in its presence. A search is therefore being made for suitable chemicals that can be added in very small quantities to salt to prevent the growth of these micro-organisms. Three treatments have been found thus far to be exceptionally promising for preventing the growth of bacteria and molds and the stains and putrefaction caused by them. These are: (1) Salt plus 0.2 percent of its weight of sodium trichlorophenate; (2) salt plus 2 percent and 0.1 percent of its weight, respectively, of sodium silicofluoride and paranitrophenol; and (3) salt plus 2 percent and 0.1 percent of its weight, respectively, of sodium silicofluoride and sodium trichlorophenate.

Curing experiments on large enough scale to give significant tannery results were made with calfskins, using the first two of these treatments. The packs were in cure for 3 months under adverse conditions of a warm temperature and a minimum of salt. The control packs, with salt containing no special preservatives, showed gradual but pronounced spoilage after the first 3 weeks, and, when taken up after 90 days, were in poor condition, having general hair slip, a foul ammoniacal odor, and a dead, dirty appearance. The two test packs with salt containing special preservatives were in much better condition, being almost free from odor and having tight hair and bright appearance. Several tanners expressed the opinion that the skins cured with treated salt were in an excellent state of preservation. All the skins are being processed by a cooperating tanner to determine the influences, if any, of the treated salts upon the various operations of tanning and, especially, to grade the final leathers for quality, selection, and value.

The organism causing flesh reddening of salted hides, a serious damage of frequent occurrence that lowers the value of hides, has been tentatively identified as *Myxococcus rubescens*, Thaxter. A stage of growth of this organism with which no well-defined stainable bacterial cells could be associated was observed for the first time as was also the organism's great variation in cell types, or appearance, depending upon the nutrients on which it grows. When isolated from contaminated salt on a fish-broth agar the organism appears entirely different than when grown on the same agar plus peptone, gelatin, casein, or various carbohydrates. This observation is of both practical and fundamental importance in that it not only helps to isolate and identify the organisms which cause spoilage of hides and skins, but also explains the origin of much confusion in this field of work.

Processors of hides and skins are continually meeting with damages of unknown origin, and tanners spend much money and time trying to determine whether the cause is in their processing and consequently within their power to correct. From a study of authentic specimens of hides and skins from the Bureau of Animal Industry important contributions were made toward the identification of damages that occur on the hides and skins of living animals. These damages, as they appear in the hide or skin and in the leather made from it, were described and illustrated in three articles published in the journal of the American Leather Chemists Association. One article shows the consequences of ringworm infection of the hide of a living animal wherein numerous lesions are formed that partly destroy the structure of the hide and the leather made from it. Another illustrates an eczema, not of parasitic origin but arising from a systemic disorder, which decreases the value of the hide by at least 50 percent, because the numerous patches of destroyed grain permit the production of nothing but low-grade leather. The third article describes a damage to hides from an infection of cattle by a parasitic nematode or worm, *Stephanofilaria stilesi*, which during the last year was definitely identified among domestic hides for the first time. On cattle in the United States infection seems to be

confined to the belly region where deep lesions develop and spread over the hide. Leather made from the infected areas is worthless. Cattlemen and farmers should familiarize themselves with these damaging disorders and take effective steps to prevent their spread. Otherwise the hides from their cattle may bring less than they should or be entirely unsalable.

The cattle-killing program of the Federal Government, entered upon as a measure of drought relief and reduction of livestock, brought with it major problems in handling the hides and skins. In order to prevent disastrous glutting of the market, all hides and skins taken off after September 5, 1934, in connection with the cattle- and sheep-killing program, remained the property of the Government instead of being turned over to the packers as was previously done. This involved the handling and storage of some 6,000,000 cattle hides, calfskins, and sheepskins, worth about \$8,000,000. The killing program introduced the important economic question as to what should be done with the hides and skins. Various plans were considered by representatives of the Government and of the industries concerned. These included the orderly marketing of the hides and skins by the Government, long-time storage and gradual release according to market demands, contract tanning and manufacture of the leather into goods for relief purposes, and use of idle tanneries and labor for tanning and making leather goods for relief purposes. The Bureau of Chemistry and Soils acted in an advisory capacity on the technical points involved in these several programs in cooperation with the Agricultural Adjustment Administration, the Federal Surplus Relief Corporation, the Federal Emergency Relief Administration, the packers, the tanners, and members of the leather trade. The Bureau, from its extensive experience, was able to offer suggestions on the program and procedure for curing, storing, and taking up hides and skins to insure the least spoilage and orderly marketing and prepared detailed descriptive matter for Government contracts for curing sheepskins, shearlings, cattle hides, kip skins, and calfskins and for holding the same with and without cold storage, and similar material for Government contracts for tanning garment, glove, shearling, shoe upper, sole, and lining leathers.

#### TANNING MATERIALS

Chestnut wood, chestnut-oak bark, and eastern hemlock bark, the principal tanning materials of the United States, are nearing exhaustion. The Bureau, therefore, is giving close attention to the development of new sources of tannin in this country. One material of promise is the bark of the Pacific coast hemlock. This bark is rich in tannin and occurs from the vast lumbering operations and pulp production of the Northwest in great quantity as a byproduct, which is not put to any useful purpose except for a very minor portion sold as "hogged" fuel at about 75 cents per ton. It is estimated that in Washington and Oregon alone about 400,000 cords of this bark are removed annually from saw logs and pulpwood. This quantity has a potential value of some \$5,000,000 as a new commercial source of tannin for making leather. An investigation on the possibility of making satisfactory tanning extracts from this waste bark that can be delivered to the consuming markets in the East at competitive prices was actively continued and is approaching completion. In the course of this study it was found that the successful utilization of the bark on a large scale depends upon artificial drying, regardless of whether the bark comes from logging ponds or direct from the woods, because of its high moisture content, climatic and woods conditions unfavorable to natural drying, and the necessity of storing the bark for 6 months or more before extracting it. Drying experiments were made on a large scale on the Pacific coast with both fresh and wet hemlock bark. It was found that artificial drying is entirely feasible, at a cost of less than \$1 per cord and without material detriment to the bark or to the yield or quality of the extract made from it.

#### LEATHER

Further progress was made in the study of the "red rot" or acid rot of leather, which has been pursued intensively during recent years because of its promise of yielding results of both fundamental significance and practical value. The results of an elaborate investigation showed the superior resistance of chrome-tanned leathers to red rot, a damage to leathers resulting from absorption of acids from the air. The important practical feature involved is that most of the bookbinding and other leathers subjected in actual use to this



type of deterioration are now vegetable-tanned. If chrome-tanned leather can be substituted for vegetable-tanned leathers for uses involving long exposure to polluted atmosphere, rotting will be slowed down greatly and the useful life of the leather will be doubled or trebled. Aside from its practical value this discovery has a fundamental bearing on the theories of tanning. Chrome-tanned leathers are shown to have a much lower rate of pick-up of acid from the air, with the formation of but little soluble nitrogen accompanying their deterioration. In contrast to this, vegetable-tanned leathers are quite basic in character, acting as attractants for the acids in the air. As a result comparatively rapid rotting of the leather sets in with the formation of a high percentage of soluble nitrogen decomposition products.

It was also found that the nontannins occurring with the natural tannins in woods, barks, leaves, and fruits used as tanning materials help to protect leather against acid rot, which is in harmony with the finding of R. F. Innes, that nontannins have a protective influence. This discovery focuses attention on the nontannins rather than the tannins for making more resistant leathers. It also helps to explain why modern leathers, with their low content of natural nontannins, are not more resistant to acid rot.

The results of this research work are serving as a guide in a program in cooperation with tanners and the Government Printing Office to develop more durable leathers for use in binding books for the Government. Thus far, 4 special leathers have been secured, 2 full-chrome-tanned sheepskins and 2 combination vegetable-chrome-tanned sheepskins, for trial as substitutes for the type of sheepskin leather commonly used on law books, which is entirely vegetable-tanned and of poor serviceability. These special leathers are being put through the Government Printing Office bindery for observation of their behavior on wetting back, pasting, stamping, and other operations. Three volumes are being bound with each leather, two being for reference and the third for natural aging. Each leather is also being artificially rotted by gas-chamber exposure to determine its comparative life and resistance to decay. Some of the new leathers are promising, and doubling the life of the average leather binding appears entirely feasible. This would result in an estimated annual saving of at least \$75,000 for leather bindings in Government libraries alone.

#### CHEMISTRY OF NAVAL STORES (TURPENTINE AND ROSIN)

Research was continued on the composition of pine gum, turpentine, and rosin, separation of components, formation of derivatives, and determination of chemical and physical properties of raw materials and derived products to acquire fundamental knowledge regarding the chemistry of pine-tree products, which may also have a practical bearing upon the increased utilization of these products for industrial purposes.

As a result of the study of resin acids in pine gum, "special rosins" possessing physical and chemical properties different from those of ordinary rosins were prepared. These were highly transparent and some so nearly colorless as to be seven grades above X, the highest grade produced commercially in this country. These special rosins may offer advantages over ordinary rosin for certain purposes and thus extend the use of rosin in industry. Application was made for a public service patent to cover the process.

A study was made of means for extracting the neutral components of rosin, usually referred to as "resenes," in connection with collaborative work for the Association of Official Agricultural Chemists on the determination of unsaponifiable matter in rosin. As a result, a radical modification of the usual methods for extracting and determining the neutral components of rosin was proposed. This should prove useful not only in providing a more dependable means for determining the suitability of rosin for certain industrial purposes, but also in providing quantitative basic information regarding the composition of rosin.

Preliminary study has shown that available methods for evaluating the total saponifiable matter in rosin are subject to several errors. Since this property constitutes an important index in determining the suitability of various rosins for soapmaking and other industrial purposes, a study of this problem is being continued.

In connection with the work on turpentine-fractionating equipment, several improvements in accessory apparatus have been developed, including a novel

precision oil gage. Application has been made for a public-service patent covering this gage.

In continuation of the fundamental research on composition and properties of American turpentine, the general objective of which is to extend the use of turpentine in chemical industries, a systematic fractional distillation was made on a large sample of steam-distilled wood turpentine and study of the composition of individual fractions was begun. Methods suitable for detection and separation of the constituents, particularly those present in small amounts, required detailed study before being applied. While the bulk of refined wood turpentine consists of alpha pinene, there are about 20 constituents, including terpene and aromatic hydrocarbons, aldehydes, secondary and tertiary alcohols, phenols, oxides, and phenol ethers. Some of the aldehydes have been identified, and study of the hydrocarbon, alcohol, phenol, and other constituents is being continued.

In continuation of the investigation on the character of turpentine and rosin in fresh pine gum, on which there has been no adequate data, work was completed on the chemical and physical constants of 173 samples of rosin made from gum collected from individual longleaf and slash pine trees, and on 42 samples of commercial gum rosin. Incidentally it was necessary to make a critical study of the methods used for the several determinations. Noticeable differences were found to exist between the rosins from longleaf pine and slash pine as regards some of their chemical and physical constants as well as between commercial rosins and rosins made in the laboratory from fresh gum. The results show the need for improvements in the usual practices of handling pine gum, and the desirability, in producing rosin for special purposes, of collecting longleaf and slash pine gums separately.

In order to obtain additional data for converting volume to weight, or weight to volume, records were kept of the specific gravity of all turpentine produced with fire and steam stills at the Naval Stores Station and of turpentine obtained by laboratory distillation from gum collected in cup tests. Gum from the cup tests, all from longleaf pine, produced turpentine having an average specific gravity of 0.8680, while turpentine from the stills had an average specific gravity of 0.8672.

Investigations upon the changes that take place in turpentine during storage were continued to show the effect of dissolved and free water in turpentine in the presence of iron and zinc (the metals with which turpentine usually comes in contact during storage) with and without the addition of certain water-absorbing chemicals. During the first year when the containers were opened only at 3-month intervals no material change took place in specific gravity or optical rotation. There was decided change in color in some cases. Free water in turpentine containing no dehydrating agent caused severe corrosion of iron and red coloration of the turpentine. The presence of oxalic acid did not prevent corrosion of iron but did prevent coloration of the turpentine. Contact of crystalline oxalic acid with turpentine during 6 months did not change any of the usually determined physical properties of the turpentine. Turpentine saturated with dissolved water quickly corroded both iron and zinc. Turpentine dried over calcium chloride did not corrode or tarnish iron or zinc in 9 months. Calcium oxide was effective in preventing rusting of iron in turpentine saturated with water, but when free water was present the lime gradually slaked and lost its effect. A commercial dehydrating agent of the alumina type proved to be impractical because it caused the turpentine to become yellow and therefore unmerchantable. While not complete, these experiments indicate that in order to prevent discoloration or clouding which will lower commercial value, turpentine stored in iron or galvanized containers should be dehydrated thoroughly.

#### TECHNOLOGY OF NAVAL STORES

Studies on equipment for the collection and handling of pine gum and on equipment and methods for the production, handling, and storage of gum turpentine and rosin were continued at the Naval Stores Station near Lake City, Fla. The purpose of this work is to reduce waste and deterioration of pine gum and its products, to raise the yield and quality of products, and to reduce costs of operation by developing and introducing improved processes, equipment, and practices.

Construction of the office and laboratory building, from funds allotted in 1934 by the Public Works Administration, was completed. New equipment for



the station includes a gum-refining plant, an aluminum vacuum still with aluminum tubular condenser, and an aluminum vacuum filter for cold gum. The gum-refining plant has a capacity of about 100 barrels of gum per 8-hour day. In building this plant care was taken to select metals and alloys that are not corroded by the action of hot turpentine gum. The digesters are of stainless steel. The storage tanks, reflux condensers, filter units, and gum lines are of aluminum. The valves are made of a special bronze-nickel alloy.

Preliminary tests were made to obtain information for use in developing the best procedure for refining gum to be used for making cleaner, paler rosins. Two distinct operations are involved. The first is the removal of all solid foreign matter by pressure filtration of the hot gum through filter paper, cotton batting, and burlap. The second is the removal of water and any contaminating dissolved material by washing and settling. The washing is effected in the storage tanks with hot water, using eductors and injectors for circulation. Separation of the wash water and gum is effected by controlling the temperature and viscosity of the gum. Rosin made from gum cleaned in the preliminary experiments had a brightness about 10 percent greater than that of rosin made from uncleaned gum of the same grade. Such rosin is more desirable for certain purposes, such as varnish making, and will probably command a higher price.

Continued use of the turpentine dehydrator built in 1934 showed that common salt was the most satisfactory dehydrating agent tried thus far. Lime, calcium chloride, sodium hydroxide, and sodium bicarbonate were tried but, because they discolored the turpentine, had to be abandoned. Many dehydrators are being installed by producers who are finding that dehydrated turpentine gives less trouble than undehydrated turpentine from leaking barrels and discoloration in shipment and storage.

A combined turpentine separator and dehydrator made of sheet copper tinned on the inside was designed and introduced. Several are in use at turpentine stills. General use of the covered separator and of the dehydrator will save the industry at least \$100,000 a year.

Continued tests with turpentine gum cups made of various materials less breakable than clay showed that after long use none is quite equal to clay cups as regards the grades of rosin obtained. The best were zinc, aluminum, and lead-dipped galvanized iron, in the order named.

About 225 charges of gum were run through the fire still. Records were made of the yield of turpentine, the yield, grade, and brightness of rosin, weights and percentages of water and other waste materials, fuel consumption per charge, amount of condensing water required, and other data pertaining to the stilling process. The stilling data were compiled and summarized in order to give naval-stores producers the first available concise and accurate information on stilling and to serve as a guide in their own practices. Average yields with charges containing 90 percent longleaf pine gum were 19.7 percent of turpentine, 67.8 of rosin, 1.7 of batting dross, 0.4 of rock dross, 2.2 of chips, 7.9 of water, and 0.3 percent of other losses. Average yields with charges containing 90 percent of slash pine gum were 18.6 percent of turpentine, 68.7 of rosin, 1.6 of batting dross, 0.5 of rock dross, 3.3 of chips, 6.9 of water, and 0.4 percent of other losses. The ratio of 1 pound of turpentine to 3.43 pounds of rosin held in the case of essentially longleaf-gum charges, and 1 pound of turpentine to 3.69 pounds of rosin in the case of essentially slash-gum charges.

From its past year's work the Naval Stores Station finds that dross, chips, and water have averaged about 550 pounds per 10-barrel charge. On the average, 1 barrel in every charge is waste. Batting dross averaged about 72 pounds and strainer dross about 20 pounds. Chips and trash ranged from about 100 to 160 pounds, and water from about 350 to 315 pounds. The dross and chips contained 58 round barrels of rosin per 10-crops basis. One hundred pounds of chips per charge costs the producer \$1 per charge in lost rosin.

About 820 barrels of gum of various grades were distilled on the steam still. By the use of high-pressure steam for heating, each of the different grades of gum was stillled under complete control. As compared with the fire still, the steam still required about 60 percent less time for distillation to start and about 40 percent less time for it to be completed. The steam still can be used efficiently for uncleaned as well as for cleaned gum. It gives somewhat higher yields of turpentine than does the fire still. The grade of rosin obtained from a particular grade of gum is the same for both types of still.

Advice on the stilling problems of individual producers and on other matters relating to naval-stores production was given through correspondence to 152 persons, and orally to the operators and visitors at 23 stills visited by members of the station staff and to the 589 persons who visited the Naval Stores Station. Plans, blueprints, line prints, and pencil sketches, covering complete lay-out of turpentine plant, design of still building, fire-still setting, and various types of equipment were distributed to 109 operators.

#### COOPERATION WITH STATES IN NAVAL STORES WORK

Cooperative arrangements were continued with the States of Florida and Georgia for the introduction of improved processes and equipment for producing naval stores through the work of cooperative agents who are employed jointly by this Bureau and State agencies.

In Florida assistance was given on problems relating to naval-stores production through 293 personal contacts and 279 letters. The cooperative agent directed the erection of 33 turpentine fire stills according to the approved plans and recommendations of the Bureau of Chemistry and Soils and the installation of 14 recording still thermometers. Of those furnished information on the covered turpentine separator and the turpentine dehydrator approved by the Bureau, about 10 percent have installed dehydrators and 25 percent have installed covered separators. The Bureau method of stilling, using the chart, graduated receiver for condensate, and with or without recording thermometer, was demonstrated to 115 operators and stillers. The cooperative agent also collected data on the cost per crop of producing pine gum when 15, 60, and 120 cups per acre are worked, on returns to gum producers compared to leasing values, and on the cost of producing turpentine and rosin.

The naval-stores cooperative agent for Georgia is making progress in introducing in that State improved practices and equipment for producing turpentine and rosin. In 137 personal contacts with naval-stores operators assistance was given in the construction of stills, in the design of and preparation of plans and specifications for improved plants, in the operation of these plants, and in solving various problems related to the production of naval stores. Thirty-five fire-still settings, according to specifications of the Bureau of Chemistry and Soils, were built under the supervision or with the assistance of the cooperative agent. Eleven improved processing plants were constructed and 52 complete sets of turpentine separators and dehydrators were installed with the assistance of the cooperative agent.

#### INDUSTRIAL USE OF FARM PRODUCTS AND BYPRODUCTS

Work on the industrial utilization of agricultural products and byproducts was continued in the field station at Ames, Iowa, in collaboration with Iowa State College.

The construction of an agricultural products laboratory, with funds from the Public Works Administration, was completed. Office and laboratory equipment were moved into the new building so far as available funds permitted. The time of the administrative and engineering staffs was largely occupied with the supervision of erection and accounting connected with the building project.

Destructive-distillation studies with continuous-process retorts were limited to experimental runs on black walnut shells and tobacco stems in the Cline retort. The walnut shells gave a yield of acetic acid of 125 pounds per ton, which compares favorably with the production of acetic acid from wood. A yield of 575 pounds of carbon per ton of walnut shells was obtained. It was found that remodeling of the internal heating element was necessary before the machine could function commercially. The Cline apparatus was taken down and reerected in the new laboratory building. On dismantling, it was found that failure of internal portions of the retort structure necessitated purchase of new parts. The lay-out for the apparatus in rebuilt form is being considerably extended.

A series of pot-still runs was made to determine the factors influencing the yield of destructive-distillation products from farm wastes and the results were prepared for publication. It was found that there is a definite relationship between the temperature of distillation and the character and yield of resulting products. Further work was done on analytical methods for deter-



mining formic acid and methoxyl in pyroligneous liquors and the results were incorporated with those of previous work for publication.

The insecticidal value of destructive-distillation oils from tobacco stems, reported last year, was confirmed by reports from the Bureau of Entomology and Plant Quarantine. Laboratory experiments were made to increase the yield of oil from tars previously obtained from plant wastes. All the tars produced in previous experimental work were distilled for the preparation of tar oils for future experimental work.

Further studies were made on the production of fuel briquettes and pressed masses from farm wastes, using various binders. Considerable work was done on the design of a briquetting machine suitable for farm-waste materials. If briquetting proves successful, crop wastes may have extensive use as fuel in regions where coal is not readily available.

In the investigation of microbial decomposition of cellulosic wastes to form fuel gas, and other useful products, experiments were made to determine the rate of break-down of cornstalks under aerobic conditions and under anaerobic conditions at moderate and comparatively high temperatures. Under aerobic conditions, the rate of break-down was practically uniform for cellulose, pentosan, and lignin. It appeared that lignin became soluble but was not destroyed. At moderate temperature under anaerobic conditions the pentosan was decomposed fairly rapidly from the start. Cellulose was decomposed more slowly at the start, but the rate of break-down gradually increased. Lignin was not appreciably attacked. At higher temperature the pentosan break-down was more rapid and that of cellulose slower, the time of fermentation being decreased 50 percent.

Experiments on the effect of added lignin upon gas production by microbial decomposition of farm wastes showed that beyond a certain point additions of lignin did not increasingly inhibit the fermentation.

In the cooperative study of a farm-unit fermentation plant for producing fuel gas from farm waste and house sewage, it was found that ordinary house sewage is usually diluted too much with water to be useful. When barnyard sewage was used, better results were obtained. Since very little livestock was available where the plant was located it was decided to repeat the experiments on another farm where conditions were more favorable, and possibly in duplicate to compare the effects of indoor and outdoor temperatures. When suitable equipment and operating conditions are worked out, farmers and small communities may be able to obtain gas for cooking and lighting from crop wastes and barnyard sewage, and to use the spent residue as fertilizer.

A study was made of the utilization of waste glucose, gluten, and other by-products of the corn-products industry in the production of butyl and isopropyl alcohols by fermentation. Glucose in 4 percent solution was completely fermented by *Clostridium butylicum* with the production of 27 percent butyl alcohol and 4 to 10 percent of isopropyl alcohol, based on the weight of sugar fermented. Corn-steep water and malt sprouts were used as sources of nitrogen. A theoretical study was made on the chemical mechanism of the fermentation.

Preliminary experiments on the preparation of alpha cellulose from cornstalks by the improved nitric acid process indicated that the process may be applicable to farm wastes other than bagasse. Good results were obtained with shredded cornstalks from which the pith had been removed. The product obtained from the pith did not appear to have commercial value.

Contact was maintained with a commercial firm which has developed equipment for the production of paper pulp from straw by a continuous cooking process. Experiments were made in the laboratory to ascertain the possibilities of continuous cooking at atmospheric pressure in apparatus other than that of the patented design. Considerable time was spent in the perfection of analytical methods suitable to waste liquors obtained in the pulping of agricultural byproducts.

#### FARM FABRICS

During the past year, through cooperative work with a commercial firm, the weather-resistant fireproofing treatment developed by this Bureau for use on cotton fabrics was converted from a laboratory treatment to a plant process. Special equipment was manufactured and assembled and subsequently modified in design. The product obtained was practically as fire-resistant as fabric treated in the laboratory. About 700 yards of fabric were treated during the course of the work. In weather-exposure tests it was

found that the fabric treated in the plant was about equal to that treated in the laboratory as regards resistance to deterioration. The results show that the treatment can be applied successfully by cotton-converting plants. If the cost can be sufficiently reduced, the treatment will be of great value in reducing fire risks where canvas is used for protective covers, tents, and awnings.

#### PAPER

An investigation on the effect of atmospheric sulphur acids on paper as indicated by gas-chamber tests was completed and the results were prepared for publication. High- and low-grade current types of book and writing papers were tightly bound in book form and exposed for 330 days in a chamber heated to a temperature of 50° C. and containing the total gaseous sulphur products of combustion produced by a small constantly burning jet of illuminating gas. Comparative chemical and physical tests were made on different sections of the leaves at the end of 90, 180, and 330 days of exposure. At the end of 330 days all the papers showed decided deterioration near the edges of the leaves. The polluted air had the least injurious effect on the rag-ledger and the highly purified wood-bond papers. They were hard-finished papers containing relatively high percentages of glue, and were among those absorbing the least acid. There was a progressive decrease in acidity and in degree of deterioration, measured by folding endurance, as the distance from the edge of the leaves increased. The center sections of the leaves absorbed little or no acid. The results show the manner in which the paper of books deteriorates when such books are exposed to atmospheres polluted with sulphur gases, as is usually the case in cities, and emphasize the importance of purifying the air of libraries and of adding to the paper at the time of manufacture a material that will neutralize or counteract acidic sulphur compounds as they are absorbed by the paper.

#### OIL, FAT, AND WAX INVESTIGATIONS

The oil, fat, and wax investigations of the Bureau relate to the composition and characteristics of agricultural fats and oils with reference to commercial requirements in order to make possible their more profitable production and utilization. Oil-bearing farm products now wasted or inadequately used are studied for the purpose of finding profitable market outlets.

#### TUNG OIL

Owing to its unique property of drying, both by absorption of oxygen and by polymerization in light, tung oil has exceptional value for the manufacture of varnishes, paints, and paint driers. The increasing demand for tung oil, fully 100,000,000 pounds of which are imported annually from China, has recently stimulated the planting and cultivation of tung trees in Florida.

In connection with this young tung-orchard industry, an investigation was made by the Bureau during the past year with reference to the composition of tung oil, using a sample expressed from Florida tung nuts. It was shown that the oil contained over 90 percent of elaeostearic acid, instead of about 73 percent as previously reported by other investigators. The remarkable drying powers and unique properties of this oil are due entirely to the large quantity of elaeostearic acid present as glyceride.

#### BAGILUMBANG (BANUCALAG) OIL

Bagilumbang or banucalag oil is obtained from the nuts or seeds of the tropical tree *Aleurites trisperma*, which is closely related botanically to the semitropical tung trees. During the past year an investigation was made by the Bureau of the oil from the seeds of a bagilumbang tree growing in calcareous soil near Homestead, Fla. It was discovered that the oil contained 67 percent of elaeostearic acid glycerides. Previously, it was believed that the oil was similar to lumbang or candlenut oil from the *A. moluccana* but this oil contains no elaeostearic acid and has notably less drying powers. Although paints and varnishes made with bagilumbang oil appear to produce waterproof films as do those made with tung oil, the former oil, as would be expected from the smaller quantity of elaeostearic acid glycerides present, does not possess such strong drying powers. In view of the composition of this oil and



the fact that the tree producing it appears to thrive on calcareous soils, cultivation experiments are planned in southern Florida and other regions having a suitable climate, but in which tung trees cannot be grown, as soon as an adequate supply of seed can be obtained.

#### SOYBEANS AND OIL

During the past year, the seed of about 50 new varieties of soybeans introduced from the Orient by the Division of Forage Crops and Diseases of the Bureau of Plant Industry were examined. As previously mentioned the chief object of this study is to find varieties, the beans of which contain oils having stronger drying powers than our domestic product, and which would be of special value to the paint, varnish, lacquer, and linoleum industries. As a result of the present investigation, two varieties of beans were found which contained oils that possessed somewhat stronger drying powers than that on our market. Cultural experiments are planned to ascertain whether these two varieties are adapted for cultivation on a commercial scale in this country.

#### PROTEIN AND NUTRITION INVESTIGATIONS

##### STUDIES ON YEAST PROTEINS

The investigation on the proteins of yeast has been continued. This work was undertaken because yeast is assuming an increasing economic and scientific importance. Yeast is being irradiated by ultraviolet light, and the product fed to dairy cows in order to increase the quantity of vitamin D in the milk. Yeast is also being increasingly used for human consumption. It is an excellent source of vitamin G ( $B_2$ ), the antipellagric factor. Large quantities have been distributed in the Southern States by relief agencies for the cure and prevention of pellagra. Yeast is also used to some extent in human consumption to supply vitamin B.

Vitamin B in basal rations used for experimental feeding studies is usually incorporated by addition of yeast. A knowledge of the amino acid content of the yeast added is important in order to evaluate the results obtained when the rate of growth is used as a criterion for the amount of the unknown substance which is being assayed. The proteins and amino acids of unknown character and quantity thus incorporated with the yeast into the experimental rations introduce complicating factors which may lead to erroneous conclusions.

When this investigation was started there was very little data or information about the actual quantity of protein in yeast or about its amino acid content. Consequently, there was no basis for making corrections to errors in feeding experiments arising from the introduction of the proteins in the yeast added.

A method was used for the extraction of the protein from yeast which enabled the separation of a much greater proportion of the protein than had been heretofore accomplished. This method involves a preliminary treatment of the fresh yeast with ether before making the extractions with the usual protein extractants. Without this preliminary treatment with ether only about 40 to 50 percent of the total nitrogen could be extracted, whereas after the ether treatment, 91 percent of the yeast nitrogen was removed.

Different fractions of proteins isolated from yeast varied greatly in their composition, particularly with respect to phosphorus, the content ranging from about 0.3 to about 3 percent. This information is important in connection with the use of yeast for preparing basal diets in vitamin determinations, particularly of vitamin D. The nutritionally essential amino acids are well represented in the yeast proteins. Not much difference was found in the amino acid contents of bakers' and brewers' yeast.

Methods developed for the determination of certain amino acids in the whole yeast showed bakers' yeast to contain 0.27 percent of cystine, 1.32 percent of arginine, and 2.15 percent of lysine. The corresponding values for brewers' yeast were similar, namely, cystine, 0.3; arginine, 1.37; and lysine, 2.61 percent. Analyses made on the isolated proteins showed them to be good sources also of histidine and tryptophane. These amino acids are indispensable for the nutrition and normal growth of animals.

The high percentages of the nutritionally essential amino acids in yeast proteins emphasize the importance of giving consideration to them in feeding experiments conducted for the purpose of studying the nutritive value for proteins when yeast is used in the ration to supply vitamins.

## STUDIES ON THE DIGESTIBILITY OF PROTEINS

Studies have been continued which were inaugurated last year on digestibility of proteins *in vitro*, with special reference to the rate of liberation of cystine from casein when the latter is subjected to tryptic digestion. It was previously shown in this Division that when casein is digested with pepsin the digestion proceeds only to the point where the protein is broken down into large fragments of the molecule, such as peptides, peptones, and proteoses. No free amino acids were found to be liberated. With trypsin, however, it was found that the digestion goes much further than with pepsin, and that cystine is liberated at an early stage of the digestion. Tryptic digestion usually proceeds most rapidly in alkaline media (pH 8 to 9). At this alkalinity, however, cystine is decomposed, so that a quantitative estimation of the amount liberated within a given time could not be determined. By conducting the digestion a little on the acid side of neutrality (pH 6.8) the cystine was gradually liberated to completion, amounting to 0.34 percent of the casein.

It has been shown elsewhere that when heated to 150° C., the biological value of casein is lowered, and that this deterioration can be compensated for by addition of lysine to the experimental diet. This observation may be explained by assuming either that the heating destroys the amino acid lysine or that the protein is so changed that a part of the lysine can no longer be used effectively by the animal for its nutritional requirements. That the latter is the true explanation, which doubtless represents a certain type or form of indigestibility, was demonstrated by determining quantitatively the amount of lysine in the raw casein and in the heated casein. In both cases identically the same quantity of lysine was isolated. It is not unlikely that a molecular rearrangement is brought about so that a part of the lysine precursors become resistant to enzymic digestion, and that this resistance explains in part the lowered nutritive value of the heated protein.

## CHEMICAL INVESTIGATIONS ON TOXIC WHEAT

Feeding experiments conducted in this Division with white rats have demonstrated that selenium in wheat cannot be removed by extraction of the wheat in the cold with water, alcohol, or ether; that it is fairly uniformly distributed in the different milling parts of the kernel, namely, the flour, bran, and middlings. Gluten prepared from toxic flour by washing out the starch was found to retain all the toxicity of the flour from which it was prepared. The two proteins, gliadin and glutenin, which comprise wheat gluten, were prepared. These proteins were found to be as toxic as the gluten. Complete hydrolysis of the toxic gluten with sulphuric acid did not destroy the toxicity. The products of hydrolysis were found to be as toxic as the unhydrolyzed gluten. The results of the feeding experiments indicate quite definitely that the selenium in the toxic wheat is present in an organic form intimately associated with or combined with the protein.

The feeding experiments have been followed by chemical investigations with the object of isolating and identifying the form in which the selenium is present in the hydrolysate after toxic gluten has been completely hydrolyzed. By applying methods of fractionation and analyses generally applied to proteins, certain fractions of amino acids have been separated which contain nearly all of the selenium in the hydrolysate. Although small fractions have been isolated that had a high concentration of selenium, they still contained too large a proportion of amino acids to enable any definite characterization of the selenium compound. The results of these studies, however, have yielded considerable information regarding the properties and nature of the selenium compound in the hydrolysate of the toxic wheat gluten.

The organic selenium compound is quite stable. There are no indications of decomposition when it is heated to boiling with 35-percent sulphuric acid or 20-percent sodium hydroxide. It is apparently an organic hydrolytic product of the protein much in the same manner as the amino acids. Like the amino acids, the selenium cannot be removed from the unhydrolyzed gluten by water, but after hydrolysis it is readily soluble in water, dilute acids, and alkalis. It is insoluble in the common organic solvents such as ether, chloroform, carbon disulphide, ethyl acetate, benzene, alcohol, and acetone. Addition of hydroxyl amine or sodium sulphite to aqueous solutions of the selenium-containing fractions does not throw out selenium, as happens in the case of many inorganic selenium salts. In general, its properties are very similar to those of the amino



acids. It is precipitated along with amino acids when they are thrown down from their solutions as salts of certain metals commonly used for the precipitation of amino acids. By systematic fractional crystallization of the hydrolytic products of toxic wheat gluten, most of the selenium is concentrated in those amino acid fractions which may be referred to as the leucine and tyrosine fractions.

#### AMINO ACID CONTENT OF WHEAT

The proteins of wheat flour consist chiefly of gliadin and glutenin. There are other proteins occurring in smaller quantities. Gliadin and glutenin occur in approximately the same proportions, although varying to some extent with the type and variety of wheat and environmental conditions. The amino acid content of gliadin and glutenin is fairly well known, but the composition of the other proteins in flour is not known. Supplementation of one food material with others in order to provide a protein mixture which will contain enough of those amino acids essential for the satisfactory nutrition of animals is a problem that not only frequently confronts investigators in nutritional work, but is of importance in the practical feeding of farm animals and in human nutrition. Knowledge of the amino acid composition of the 1 or 2 chief proteins of food materials will not suffice because of the amino acids present in the other proteins in quantities concerning which there is little or no information. Furthermore, many naturally occurring foods contain free amino acids that are not combined with any protein. Using wheat or wheat flour as an illustration, the total amount of lysine, cystine, or any other amino acid in a pound thereof is not known. If it were desired to add to the wheat some other cereal or nitrogenous product so as to bring the mixture up to a certain definitely desired amino acid content, it would obviously be necessary to know the percentages of the amino acids in the total materials which were mixed.

Methods for the determination of amino acids in isolated and purified proteins are available, but no satisfactory method has been worked out for determining the total amino acids in staple foods, such as cereals, flour, nuts, meat, eggs, milk, etc.

Direct hydrolysis in the manner generally applied to purified proteins in amino acid determination is not applicable to food material such as flour, meals, seeds, etc., because hydrolysis in the presence of starch and other nonprotein substances results in the decomposition of cystine and histidine, two of the amino acids essential for the growth and nutrition of animals. In studies carried on to ascertain the quantity of certain nutritionally essential amino acids in wheat flour, this difficulty has been largely overcome by hydrolyzing extracts obtained by treating the flour with suitable solvents which removed the nitrogenous compounds practically quantitatively.

Working with a popular brand of commercial wheat flour, it was found that it contains 0.31 percent cystine, 0.16 tryptophane, and 0.22 percent lysine. When one considers that only about 12 percent of the flour represents protein material these figures place the total flour protein in a more favorable light with respect to the above-named amino acids than is generally appreciated, and it does not compare unfavorably with purified casein (cystine, 0.31 percent; tryptophane, 2.09 percent; lysine, 7.6 percent).

#### BIOLOGICAL STUDIES ON COTTONSEED OIL

Refined cottonseed oil, a uniformly hydrogenated cottonseed-oil shortening, and a cottonseed-oil shortening made by mixing the oil and a highly hydrogenated oil were all found to be excellent media for carrying carotene. There was no measurable loss of carotene either biologically or spectrophotometrically following 6 months' storage at room temperature. This fact is important because it shows that these oils may be used advantageously and safely, within the time mentioned, as diluents and carriers for carotene, which is used internationally as a standard for vitamin A.

#### ALPHA- AND BETA-CAROTENE AS SOURCES OF VITAMIN A

The studies on the value of alpha- and beta-carotene as sources of vitamin A have been completed. It was shown that there is a distinct difference in the biological value of these two substances. The international standard for

vitamin A was used as a basis for comparing the potency of the two preparations. The alpha-carotene had about 85 percent of the vitamin A value of the international standard and the beta-carotene was about 50 percent more potent than the international standard. In other words, alpha-carotene was found to have about 56 percent of the potency of beta-carotene. There is a theoretical basis and some experimental work to support the view that a molecule of alpha-carotene will form only one molecule of vitamin A while a molecule of beta-carotene will form two molecules of vitamin A. This Bureau's findings lend support to the view that gamma-carotene and cryptoxanthin, which also serve as sources of vitamin A, are only one-half as valuable as beta-carotene. These results have an important bearing on attempts to establish vitamin A potency of plant products by chemical and physical methods. The results were also used in defining the international unit for vitamin A in terms of beta-carotene.

#### INTERNATIONAL VITAMIN CONFERENCE

At the International Vitamin Conference attended by a member of this Bureau new standards were adopted for vitamins A and C. Due to some technical difficulties in using the first standard for vitamin A and also to the fact that much information concerning carotene had been developed since the first conference, it was deemed advisable to adopt beta-carotene dissolved in vegetable oil as a standard for vitamin A. The chemical nature of vitamin C has been definitely established and the pure vitamin called ascorbic acid is now available. Since this substance is sufficiently stable to permit its distribution and use for biological studies, it was adopted as a standard for vitamin C.

#### COLOR AND FARM-WASTE INVESTIGATIONS

##### FAST DYES FOR AGRICULTURAL FIBERS

The work of the Bureau in color and farm-waste research has resulted in the establishment of several industries which have directly stimulated utilization of domestic farm products and have created new market outlets. The American vat-dye industry, made possible by the method developed by the Bureau for the production of phthalic anhydride, has not only broken foreign monopoly but has effected drastic economies in vat-dye manufacture. By use of vat-dye colors it is possible to obtain attractive effects more cheaply with domestic cotton, wool, and synthetic fibers, thereby widening the market for these agricultural materials. The result has been the expansion of the use of American textiles and decreased use of textiles of foreign origin.

During the past year the Bureau has discovered a new process for doubling the yields of a whole series of ketones which are valuable in the manufacture of intermediates for dyestuffs and medicinals. It has also set forth the important theoretical considerations which underlie the reactions employed. These discoveries and reports are not only of fundamental importance in revealing the mechanism of the Friedel and Crafts reactions in organic syntheses but also make possible great monetary savings to industry through more efficient synthetic processes.

##### BIOLOGICAL STAINS

The Bureau continues its work in cooperation with the commission on standardization of biological stains by establishing and maintaining a satisfactory source of stains for the use of the biological scientists of this country. Research of the past year on biological applications of dyes resulted in the discovery of benzoyl auramine G, a new indicator suitable for use in routine Kjeldahl determinations, and requests for small amounts of this indicator have been received.

##### BAGASSE CELLULOSE

The experimental work on utilization of sugarcane bagasse is assuming increased importance. Tests made by the Bureau have shown that an excellent grade of alpha-cellulose can be produced from sugarcane bagasse, thus opening a promising market for the 500,000 tons of waste sugarcane fiber available annually in the continental United States. Industrial experiments based on these results, in which the Bureau has cooperated in an advisory capacity, have indicated that there should be no difficulty in making use of sugarcane fiber to supply needs arising from a shortage of cotton linters. As a result of an



experiment in collaboration with this Bureau, a commercial company at Maui, Hawaii, has recently built and is operating a pilot plant producing 2,000 pounds of high-grade cellulose daily. Under the direction of a specialist from the Bureau, a cellulose was produced at an estimated cost of about \$50 a ton which compared favorably with the best commercial material obtainable.

#### INDUSTRIAL FERMENTATIONS

The chemical action of micro-organisms is receiving attention both from a fundamental and a practical standpoint. Since work was started in the Bureau on industrial fermentations a few years ago, the Bureau has become recognized as a leading authority on the subject.

A new technic, involving the use of aluminum rotary drum fermenters, has been devised by the Bureau for carrying out oxidative fermentations under increased air pressures. This procedure makes possible the use of submerged mold growths in industrial processes and will greatly reduce the cost of certain fermentation products, such as calcium gluconate.

A species of mold has been found that will give high yields of dextro-lactic acid (sarcos-lactic acid) as a result of its action on glucose. Dextro-lactic acid, a new product expected to have technical uses, may be produced in the solid form, which will make it more convenient for handling and shipping than is the ordinary liquid lactic acid. New applications may also be found for some of its derivatives, notably the calcium salt. Dextro-lactic acid has not been produced in appreciable quantity heretofore outside of a living animal body, where it exists as a constituent of muscular tissue.

#### LIGNIN

The profitable utilization of lignin, which represents about 30 percent of the dry material in all vegetation and one of the greatest farm wastes, continues to be the object of continuous research by the Bureau. During the past year fundamental studies on the chemistry of lignin were continued; also work on the ammoniation of waste sulphite lignin, with a view to utilizing the ammoniated product as a nitrogenous fertilizer. In the experiments on ammoniation of lignin it was possible to obtain a product containing over 11 percent nitrogen, and greenhouse experiments during the past year indicate that this material may become a successful carrier of nitrogen for the plant.

Studies on the decomposition of lignin and other plant components in alfalfa hay by thermophilic bacteria indicate that, in general, lignin is the most resistant to microbial attack of all the major plant constituents. As a result of microbial activity there is an accumulation of lignin in the residue, which it appears from studies of the past year, plays an important part in the spontaneous ignition of hay and similar agricultural materials.

#### DUST-EXPLOSION INVESTIGATIONS

The Bureau of Chemistry and Soils is the only governmental agency studying dust explosions in agricultural operations and in industrial plants. It is looked to, both in the United States and in foreign countries, for technical information on the subject. The investigations relate directly to the development of methods and appliances for the saving of life, property, and foodstuffs.

Eight dust explosions were investigated by the Bureau during the past year. These explosions resulted in the destruction of property valued at \$1,150,000 and in the death of 11 persons and injury to 16 others.

The two explosions which caused the heaviest loss during the year were those at Newport News, Va., on November 8, and at Omaha, Nebr., on November 23.

The elevator at Newport News was a wood-frame metal-clad structure, and the fire that followed the explosion completely destroyed the building and the grain it contained. The explosion occurred while grain was being turned and in connection with this operation fumigation or treatment of the grain to kill weevils was in progress or had just been completed. The men engaged in this operation were killed. In view of the fact that the use of a fumigant may have been associated with this explosion, it has been suggested that studies be made to determine whether fumigants, presumably safe based on laboratory tests, are safe at all times during or after application as practiced in industrial plants.

The explosion at Omaha occurred in a new type of elevator, radically different from the usual type of grain storage plant, and the method by which the ex-

plosion in this house vented itself through the roof indicated the value of light construction for the release of explosion pressures. In the opinion of the investigators a much more severe explosion with greater life and property loss would have occurred if the plant had been of heavier construction.

#### ARLINGTON TESTS ON DETERMINATION OF RATIO OF EXPLOSION PRESSURES TO VENTING AREA

The testing work now under way is designed to show the venting area necessary to release explosion pressures produced by ignition of dust clouds of different particle size. Tests have indicated the particle size of grain dust necessary to propagate flame and the size required to produce explosive pressures. The venting area necessary to release these pressures without structural damage has been determined for grain dust, and it is planned to continue the work with other kinds of dust.

A considerable amount of testing was done during the year in order to determine the comparative value of top and side vents for releasing dust-explosion pressures in tall towers, tanks, or bins.

A series of tests was included in the above program to determine the maximum permissible length of a venting duct designed to carry explosion pressures from a bin, elevator leg, or enclosure within a building to the outside.

Some preliminary work was carried on to determine the possibility of using preaction vents designed to open under a temperature rise or a slight increase in pressure, and thus be in position to release an explosion should one occur. This work indicated the possibility of using the initial pressure wave of an explosion to operate some equipment or stop some mechanism in another section of a plant, but further work will be necessary to determine how effective such apparatus will prove to be.

Further tests were made during the year with different types of glass scoring designed to weaken windowpanes, and thus permit the release of explosions at lower pressures.

A number of demonstrations were given during the year at the Arlington station to show how dust-explosion pressures could be released through properly proportioned and properly located vents without damage to the structure. Visitors to the station to witness demonstrations included grain-elevator officials and operators, railroad fire-protection engineers, manufacturers, students, and members of 4-H clubs.

#### EXPLOSIBILITY AND IGNITION TEMPERATURES OF VARIOUS DUSTS

The lower limits of concentration for explosion of wood dust from 7 conifers, 6 broadleaf woods, and 4 barks were determined by the Bureau during the past year. In addition tests were made to determine the maximum pressure, and maximum and average rates of pressure rise at concentrations of 10, 25, 50, 100, 250, 500, 750, and 1,000 mg per liter for the 17 dusts. In some instances, due to the low density of the dust, the capacity of the apparatus was not great enough to hold the amounts required for the higher concentrations, which prevented the making of tests at those concentrations. These tests give a complete story on the explosibility of these wood and bark dusts.

The lower limit of concentration for explosion of ground malt and barley and malt elevator dusts and the maximum pressure and maximum and average rates of pressure rise were determined over a wide range of concentrations.

The ignition temperatures of barley and malt elevator dusts are 247° and 252° C., respectively. These are lower than those previously reported for wheat and corn elevator dusts, which were 265° and 267°. The ignition temperature of ground malt is 319°, which compares favorably with cornstarch and hard wheat flour.

#### SCHOOLS OF INSTRUCTION FOR FIREMEN

The Bureau cooperated actively with the various States in presenting the dust-explosion prevention work at schools of instruction for firemen. Addresses and dust-explosion demonstrations were presented at the following meetings: Lancaster County Firemen's School, Lancaster, Pa. (Millersville State Teachers' College); International Fire-Fighters' Convention, Cedar Point, Ohio; International Association of Fire Chiefs' Convention, Milwaukee, Wis.; Pennsylvania State Firemen's Association Convention, Sunbury, Pa.; Illinois State Firemen's Association Convention, Granite City, Ill.; Iowa State Fire College, Ames, Iowa; and Training Institute for Fire Chief, Syracuse, N. Y.



## SPECIAL MEETINGS

The dust-explosion-prevention work was presented at a large number of special meetings in various sections of the country throughout the year. Among the more important meetings were the following: National Fire Protection Association meetings at Atlanta, Ga., Atlantic City, N. J., and Boston, Mass.; annual meeting of Grain Elevator Superintendents, Chicago; annual meeting of Operative Millers' Association, St. Louis, Mo.; conference with railroad officials, Philadelphia; and meeting of committee on static electricity, National Fire Protective Association, New York.

During the year a number of conferences were held with representatives of industrial companies and trade associations to discuss various dust-explosion-prevention problems.

## FARM FIRES

## LARGE-SCALE EXPERIMENTS ON SPONTANEOUS IGNITION OF HAY

Recognizing the need for extending research into the field, the Bureau has been conducting for several haying seasons at the Experiment Farm, Beltsville, Md., large-scale experiments on the spontaneous heating and ignition of hay. The purpose of these experiments was to study some of the causes and the effects of the self-heating and ignition of long hay in storage and of developing practicable methods of prevention and control.

The tenth experiment of this series, designed primarily for studying the efficacy of salt as a retardant or preventive of spontaneous heating and ignition, was carried on during the summer of 1934.

As a general observation, this experiment indicates that 1½ percent by weight of salt added to 12½-ton lots of long alfalfa hay averaging 35-percent moisture content has no appreciable effect as a preventive or retardant of spontaneous heating.

One phase of the investigation of the causes and effects of the spontaneous heating of hay in large-scale experiments was a study of the gases formed during the heating. Closely related to this study was a laboratory investigation of the oxidation of hay under the influence of heat supplied from external sources. As a result of the consideration of the results of these two lines of investigation, it has been possible to form some important conclusions regarding the nature of the oxidation occurring in the mow undergoing spontaneous heating. The results indicate that along with the respiration processes of the living plant cell and the activity of micro-organisms, chemical oxidations also occur throughout the whole range of temperature usually ascribed to biological agencies. The results further lend support to the view that in spontaneous heating of hay unsaturated, easily oxidizable chemical substances are formed, which would at least partially account for the ready consumption of oxygen. The results of this phase of the investigation are embodied in a manuscript entitled, "Oxidation and gas formation in the spontaneous heating of hay", which has been submitted and approved for publication.

Another line of investigation connected with the large-scale experiments and which was continued in the experiment ended in the present fiscal year was that of the losses of hay substance resulting from the excessive fermentation of improperly cured hay as stored in these experiments. It is proposed to present the results of this investigation for publication, and to this end considerable progress has been made in preparing the manuscript. The results of this work confirm previous opinions of the great seriousness of the losses from the spoilage or complete destruction of farm produce incident to excessive spontaneous heating which may occur and often does occur without reaching the temperature limit at which ignition occurs.

An investigation related to the general problem of spontaneous heating is that of the individual constituents of hay which may be attacked during spontaneous heating. Progress has been made in the separation and examination of the constituents which are soluble in organic solvents.

## SOIL INVESTIGATIONS

The importance of fundamental knowledge of the soils of the United States has never been greater than at present or more generally appreciated. The fundamental fact of agriculture is the relationship between the plant root and the soil in which it grows. Each plant has specific requirements and each

type of soil certain capabilities under methods of management which man may employ. More than upon anything else, successful agriculture is predicated upon a successful adjustment of plant and soil. Crops and farmers fail on soils which are better suited to grazing and forests than to farming, soil erodes when wrongly used, and taxes become delinquent in those areas where the land is unsuitable for intensive use. To the extent that the individuals or governments affected by these problems cope with them through the adoption of rational policies of land use, such programs must be based on a fundamental understanding of the soil and its capabilities.

#### SOIL SURVEY

During the past fiscal year 23,590 square miles of rural lands in 28 States and Puerto Rico were mapped by the Division of Soil Survey. This brings the total area covered by the Soil Survey to somewhat more than one-half the arable lands of the Nation. Essentially all of this work is accomplished in direct cooperation with local State agencies, especially the State agricultural experiment stations. In this way the broader perspective of the Federal organization and the more detailed local knowledge of the State agency can both be utilized, each supplementing the other.

These maps furnish the fundamental groundwork for planning a land policy by individuals and by various governmental agencies, both local and national. The soil maps, together with the accompanying reports giving descriptions of the soils and their uses, provide farmers and local officials with a practical working handbook of the soil.

The extended use of these maps whenever they are available for determining land-use policies testifies to their accuracy and value. In 1931 a detailed soil survey was initiated in North Dakota at the request of the local people as a basis for the classification of lands for the purpose of appraisal for taxation. This work has been continued in additional areas during the past year. An explanation of the logic and procedure of the method currently used to classify land for purposes of tax assessments was published recently by the Bureau as Technical Bulletin 469, *A Method of Rural Land Classification*.

During the past year this Bureau, in conjunction with the Washington State Agricultural Experiment Station began a somewhat similar survey in western Washington. The Federal Soil Survey is cooperating with the seven experiment stations concerned with the agricultural program in the Tennessee Valley for a detailed survey of that area.

For the purpose of carrying out the Department's policy of removing land from the production of surplus crops, especially where these crops are produced only at a low labor income for the operator, the Division of Soil Survey furnishes the necessary information required to readjust the use of these areas for other crops, grazing, or forestry.

In the Western States the soil survey is proving of incalculable value in the extension of the acreage of certain special crops and at the same time serves to point out the areas where the accumulation of salts and the development of alkali would be a menace to irrigation projects. The selection of those soils suitable for the production of cotton and those best adapted to other crops in southern areas infested with the bollweevil has been greatly expedited by the use of the soil maps. Land suitable for the production of high-quality tobacco is selected through the use of soil maps where they are obtainable.

Interpretation of experimental work in the use of lime, fertilizers, and other farm-management practices depends on the soil survey. Experimental results on one soil type may be applied to other areas of that same soil. Because of the exact descriptions and classification of soils contributed by the Soil Survey, it has become more and more the policy of experiment station workers and county agricultural agents to make their recommendations regarding agricultural practices by soil type. The work of experiment stations finds its application through the Soil Survey.

Tables 1 and 2 show the details of the work done during the fiscal year 1935, the areas covered, and their distribution.



TABLE 1.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1935*

State or Territory	Area	Area surveyed	
		Square miles	Acres
Alabama	Elmore County	24	15,360
	Hale County	<sup>1</sup> 148	94,720
	Marion County	<sup>1</sup> 85	54,400
	Sumter County	<sup>1</sup> 374	239,360
Arizona	Casa Grande area	<sup>1</sup> 346	221,440
California	Pixley area	<sup>1</sup> 216	778,240
	Visalia area	<sup>1</sup> 42	26,880
	Sacramento-San Joaquin Delta area	500	320,000
Georgia	Toombs County	<sup>1</sup> 240	153,600
Idaho	Bingham County	39	24,960
	Bonner County	<sup>1</sup> 174	111,360
Indiana	La Porte County	<sup>1</sup> 153	97,920
	Cerro Gordo County	165	105,600
Iowa	Decatur County	<sup>1</sup> 375	240,000
	Jackson County	237	151,680
	Osceola County	<sup>1</sup> 112	71,680
	Story County	186	119,040
Kansas	Allen County	<sup>1</sup> 145	92,800
	Cheboygan County	<sup>1</sup> 103	65,920
Michigan	Clinton County	159	101,760
	Mason County	53	33,920
Minnesota	Pine County	<sup>1</sup> 340	217,600
	Frontier County	376	240,640
	Garfield County	218	139,520
	Gosper County	464	296,960
Nebraska	Hayes County	722	462,080
	Lancaster County	118	75,520
	Loup County	576	368,640
	Grafton County	178	113,920
New Hampshire	Albany-Schenectady Counties	<sup>1</sup> 209	133,760
	Cattaraugus County	<sup>1</sup> 305	195,200
	Niagara County	85	54,400
	Onondaga County	<sup>1</sup> 328	209,920
	Otsego County	<sup>1</sup> 352	225,280
	Ulster County	<sup>1</sup> 574	367,360
New York	Cartaret County	<sup>1</sup> 402	257,280
	Clay County	<sup>1</sup> 41	26,240
	Stokes County	<sup>1</sup> 180	115,200
	Warren County	145	92,800
North Carolina	Billings County	<sup>1</sup> 602	385,280
	Morton County	<sup>1</sup> 254	162,560
North Dakota	Tuscarawas County	106	67,840
	Garfield County	<sup>1</sup> 464	296,960
	Major County	<sup>1</sup> 484	309,760
	Murray County	<sup>1</sup> 271	173,440
Ohio	Pontotoc County	<sup>1</sup> 173	110,720
	Tulsa County	<sup>1</sup> 172	110,080
	Washita County	<sup>1</sup> 306	195,840
	Umatilla County	<sup>1</sup> 22	14,080
Oregon	Bucks County	<sup>1</sup> 246	157,440
Pennsylvania	Huntingdon County	<sup>1</sup> 196	125,440
Puerto Rico	Island	<sup>1</sup> 666	426,240
Rhode Island	Kent and Washington Counties	<sup>1</sup> 61	39,040
South Carolina	Edgefield County	<sup>1</sup> 32	20,480
	Pickens County	<sup>1</sup> 42	26,880
Tennessee	Sumter County	<sup>1</sup> 234	149,760
	Jefferson County	262	167,680
	Fannin County	<sup>1</sup> 162	103,680
	Kaufman County	366	234,240
Texas	Maverick County	<sup>1</sup> 424	271,360
	Williamson County	<sup>1</sup> 84	53,760
	Virgin River area	195	124,800
	Salt Lake Valley area	223	142,720
Utah	Albemarle County	<sup>1</sup> 302	193,280
	Halifax County	<sup>1</sup> 198	126,720
	Isle of Wight County	143	91,520
	Mecklenburg County	79	50,560
Virginia	Washington County	31	19,840
	Kitsap County	371	237,440
	Kittitas County	55	35,200
	Snohomish County	435	278,400
Washington	Yakima County	482	308,480
	Fremont County	862	551,680
Wyoming	Uinta County	<sup>1</sup> 1,536	983,040
Total		21,030	13,459,200

<sup>1</sup> These figures do not include portions of these areas surveyed in preceding years.

TABLE 2.—Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1935, and the areas previously reported

## DETAILED

State or Territory	Work during 1935	Work previously reported	Total	
	Square miles	Square miles	Square miles	Acres
Alabama.....	631	58,886	59,517	38,090,880
Arizona.....	346	4,136	4,482	2,868,480
Arkansas.....	—	15,547	15,547	9,950,080
California.....	1,758	35,632	37,390	23,929,600
Colorado.....	—	5,865	5,865	3,753,600
Connecticut.....	—	1,704	1,704	1,090,560
Delaware.....	—	2,276	2,276	1,456,640
Florida.....	—	15,160	15,160	9,702,400
Georgia.....	240	35,947	36,187	23,159,680
Idaho.....	213	12,312	12,525	8,016,000
Illinois.....	—	6,770	6,770	4,332,800
Indiana.....	153	21,039	21,192	13,562,880
Iowa.....	1,075	49,334	50,409	32,261,760
Kansas.....	145	16,641	16,786	10,743,040
Kentucky.....	—	5,542	5,542	3,546,880
Louisiana.....	—	17,431	17,431	11,155,840
Maine.....	—	2,197	2,197	1,406,080
Maryland.....	—	13,959	13,959	8,933,760
Massachusetts.....	—	8,811	8,811	5,639,040
Michigan.....	315	32,069	32,384	20,725,760
Minnesota.....	340	12,241	12,581	8,051,840
Mississippi.....	—	30,740	30,740	19,673,600
Missouri.....	—	37,177	37,177	23,793,280
Montana.....	—	3,287	3,287	2,103,680
Nebraska.....	2,474	65,418	67,892	43,450,880
Nevada.....	—	652	652	417,280
New Hampshire.....	178	1,411	1,589	1,016,960
New Jersey.....	—	9,895	9,895	6,332,800
New Mexico.....	—	2,565	2,565	1,641,600
New York.....	1,853	34,431	36,284	23,221,760
North Carolina.....	768	47,332	48,100	30,784,000
North Dakota.....	856	20,947	21,803	13,953,920
Ohio.....	106	18,407	18,513	11,848,320
Oklahoma.....	1,870	22,300	24,170	15,468,800
Oregon.....	22	15,799	15,821	10,125,440
Pennsylvania.....	442	22,083	22,475	14,384,000
Puerto Rico.....	666	2,100	2,766	1,770,240
Rhode Island.....	61	1,523	1,584	1,013,760
South Carolina.....	308	26,525	26,833	17,173,120
South Dakota.....	—	8,286	8,286	5,303,040
Tennessee.....	262	11,198	11,460	7,334,400
Texas.....	1,036	64,258	65,294	41,788,160
Utah.....	418	2,497	2,915	1,865,600
Vermont.....	—	1,175	1,175	752,000
Virginia.....	753	14,073	14,826	9,488,640
Washington.....	1,343	10,752	12,095	7,740,800
West Virginia.....	—	23,683	23,683	15,137,120
Wisconsin.....	—	26,659	26,659	17,061,760
Wyoming.....	2,398	9,929	12,327	7,889,280
Total.....	21,030	908,551	929,581	594,931,840

## RECONNAISSANCE

State or Territory	Work during 1935	Work previously reported	Total	Acres
Alaska.....	—	31,915	31,915	20,425,600
Arkansas-Missouri.....	—	58,000	58,000	37,120,000
California.....	—	32,135	32,135	20,566,400
Kansas.....	—	39,960	39,960	25,574,400
Michigan.....	—	1,322	1,322	846,080
Minnesota.....	562	11,074	11,636	7,447,040
Montana.....	2,098	49,685	51,783	33,141,120
Nebraska.....	—	53,064	53,064	33,960,960
North Dakota.....	—	39,240	39,240	25,113,600
Ohio.....	—	41,420	41,420	26,508,800
Pennsylvania.....	—	41,405	41,405	26,499,200
South Dakota.....	—	41,400	41,400	26,496,000
Texas.....	—	152,855	152,855	97,827,200
Vermont.....	—	9,124	9,124	5,839,360
Washington.....	—	16,540	16,540	10,585,600
Wisconsin.....	—	14,425	14,425	9,232,000
Total.....	2,660	633,564	636,224	407,183,360



## SPECIAL WORK OF THE SOIL SURVEY

In addition to the publication of 28 soil-survey maps and reports and other bulletins reporting results of regular projects, members of the staff have given a great deal of time to special problems in connection with the various activities relating to land use of the Federal Government and of cooperating State agencies.

As the soil-survey data are necessary and basic for almost all kinds of agricultural activity, thousands of private individuals and organizations seek the advice and assistance of the soil scientists of the Bureau, both as to the location of actual soil types and the interpretation of soil-survey data in terms of practical agriculture. Typical of these special services the following may be mentioned:

## SUBSISTENCE HOMESTEADS

During the past fiscal year the Division of Subsistence Homesteads has called on the Division of Soil Survey for continued assistance. Scientists in the Division have made detailed soil maps of several tracts of land to determine the suitability of the soils for the production of garden vegetables. About 18 such projects were examined and reported.

## SHELTERBELTS

In order to plan the development of shelterbelts in the Great Plains, detailed information is required regarding the nature and distribution of the various types of soil. The general area includes many soil types, varying widely in their capability to produce trees. Certain soils are best suited to particular species of trees; some cannot be expected to support any sort of tree growth. Several soil scientists from the Soil Survey have been securing the data necessary for planning these plantings.

## SOIL EROSION

Serious injury to soils through erosion generally occurs when they are wrongly used. The fundamental nature of the soil type determines its erosivity. The published soil maps serve as a basis for erosion surveys and erosion-control projects. In many cases where these maps have been unavailable, scientists in the Soil Survey have made special studies and maps for the use of Federal and State agencies charged with the responsibilities for erosion control.

## FARM CREDIT

Not only have the land appraisers of the Farm Credit Administration made wide use of the soil-survey maps and reports now available but have also called upon several scientists of the Soil Survey staff to assist them in conducting schools for land appraisers in order that they may recognize the individual soil types and understand their capabilities for agricultural use.

## PEAT

During the past fiscal year the work in peat investigation continued along the following lines:

(1) Inventory of the acreage, location, and geographic distribution of peat and muck resources.

(2) Improvements of technic of peat-profile morphology, identification of organic materials, and classification of peat land on a national and international basis.

(3) Collecting basic information relating to the selection and use of peat deposits for domestic grades of peat in place of imported peat products—for improving the physical condition of arable mineral soils, and for supplying raw material to a future chemical industry.

(4) Cooperation with Federal and State agencies in research and in planning the use of submarginal peat areas to alleviate the menace of floods, erosion, and silting, and the retention of unprofitable types of peat land for waterfowl, fur bearers, and wildlife.

## SELENIUM

During the past fiscal year the Division of Soil Survey detailed two specialists for a part of their time to assist in the selenium investigations being carried on by the Bureau. Examinations were made of the shales, soils, and vegetation in several States, and the results are incorporated in the report of the Division of Soil Chemistry and Physics contained in this publication.

## SOIL SURVEY OF PUERTO RICO AND HAWAII

Under an allotment of funds from the sugar-processing tax of the Agricultural Adjustment Administration, the Soil Survey has undertaken the detailed survey of the soils of Puerto Rico and Hawaii. The work in Puerto Rico will be completed during the coming fiscal year, and that in Hawaii will require a few months longer. These soil maps will furnish the basis for planning the necessary agricultural adjustments.

## SOIL CHEMISTRY AND PHYSICS

The work of the Division of Soil Chemistry and Physics during the past year has centered around four major problems. These are the physical and chemical study of the soils from the erosion experiment stations; the study of soils and colloids with reference to soil classification; study of the occurrence and distribution of selenium in agricultural areas; and the service work of the Division.

Besides these, work is being conducted along other lines which include the moisture relations and chemical constitution of peat; the relation between soil composition and the toxic effect of arsenic upon vegetation; and the study of the causes of infertility of certain soils.

## STUDIES ON SOILS FROM THE EROSION STATIONS

Continuing the investigation of the soils from the erosion stations a very complete study of the exchangeable bases and acids of the colloids has been made and the results published in Technical Bulletin 461. These investigations have shown, through the wide differences in the base-exchange relation, the necessity for different soil treatments in the handling of the divergent soil types. A new investigation of great interest is under way in connection with the trace elements which appear in these soils. It has been demonstrated that all of them contain, to varying degrees, selenium, arsenic, cobalt, nickel, zinc, copper, chromium, vanadium, and barium. It becomes increasingly apparent that these trace elements play an important role in soil behavior, and this investigation, together with those undertaken elsewhere, appears to make imperative a broad study of these relationships.

## SOIL AND COLLOID COMPOSITION

During the year two investigations have been completed in the field of soil and colloid composition. One of these concerns the detailed chemical composition of typically representative profiles of the great soil groups. This work has been reported in a technical bulletin now in press. The work clearly demonstrates that in the great morphological groups the chemical composition of the active component of the soil, the colloid, is characteristic for each group, and that for proper and intelligent control of the soil the treatment must be adapted to the particular characteristics shown. In addition, an indication is found which points to a method of simplification of soil classification which will assist materially in the solution of land-use problems.

A second investigation which has been completed involves a study of the chemical composition of the soils of the semiarid areas. This work is reported in a bulletin that has been submitted for publication. This research has shown that soils and colloids of the semiarid areas owe their characteristic differences primarily to the parent material, which is in sharp contradiction to the results previously found for humid soils. One of the important inferences to be drawn from this study is the necessity for studies of inherent productive capacity of virgin soils.

A third study, nearing completion, is concerned with the base-exchange capacity, neutralization curves, and the maximum acids shown by the colloids



of the great soil groups. This study, when completed, will give the scientific explanation for the differences which reveal themselves in the great deterioration of such soils by use, and will make for more satisfactory recommendations in connection with soil control.

In various parts of the United States closely related soil series are derived from the same parent material under the same climatic conditions. A very intensive study of one of these groups is being undertaken in order to determine what the differences are, and, if possible, their causes.

A fifth investigation which is begun concerns itself with the soil differences manifested under widely different climatic conditions when the parent material is as nearly as possible the same. It is hoped that this study may produce results of value in relation to the soil morphology of the soils of the Atlantic coast.

A sixth investigation concerns itself with the study of the soil composition of limestone soils developed under different climatic conditions, together with a study of the parent material. It is to be expected that this investigation will reveal the causes of the variation in character manifested by these soils.

#### SELENIUM INVESTIGATIONS

During the past year the investigations of the distribution of selenium have continued, and the first detailed report will appear in a technical bulletin now in press. This report presents a synopsis of the data accumulated previous to January 1, 1935. The presence of selenium in quantities which appear to call for serious consideration has been shown in soils and vegetation in seven States. The study has shown that the problem is an exceedingly complex one, in that the selenium in vegetation depends not only upon the quantity of selenium present in the soil, but upon its distribution within the profile and upon the kind of plant, and apparently upon its degree of maturity. The work was continued with support of emergency funds until the end of the fiscal year 1935, and is now being continued under the usual conditions of scientific research.

A number of areas are under investigation and it has been shown that at least two irrigation areas have a serious selenium problem, though it begins to appear that in such areas remedial measures are available. A number of new areas of seleniferous soils have been discovered, and a study of these soils and their vegetation is proceeding. In addition, advantage is being taken of the wide difference between the rainfall of the present year, as compared with previous years, in an endeavor to gain information on the effect of rainfall upon the intake of selenium by plants. Supplementary investigation in connection with selenium in soils, vegetation, and animal organisms has been started at a number of the universities and by private organizations as a consequence of the discoveries so far made.

#### SERVICE WORK

The Division is called upon to make routine measurements, both physical and chemical, on soils and soil materials for numerous governmental agencies, particularly the Division of Soil Survey. In addition, queries are frequently received from officials of the Government and from individuals which require minor tests for proper reply. The tests most frequently required are mechanical analyses to determine soil specifications in connection with contracts, hydrogen-ion concentration, soluble-salts content, and identification. During the course of the year several thousand of such determinations have been made.

#### MISCELLANEOUS INVESTIGATIONS

An investigation has been completed dealing with the effect of soil colloids of varying composition upon the availability of arsenic as affecting plant growth. The results have been prepared for publication. They show that while arsenic administered in quantities comparable with those sometimes employed will produce serious inhibition of yields, at least in the case of the control plant employed, the degree of inhibition varies widely with the soil type. The results point clearly to the necessity of careful consideration of the quantities of arsenic which may safely be used in insecticidal control.

The studies of infertile soils which have been continued for several years have been completed, so far as they concern a group of soils derived from serpentine, and which cover wide areas in the United States and elsewhere. The results of these studies have been published in Technical Bulletin 471. They show that in addition to the unfavorable physical characteristics shown by these soils, they contain abnormally large quantities of magnesium, chromium, and nickel, any or all of which may contribute to the low productivity. Studies along this line are being continued in an effort to determine the relation of barium, which occurs widely distributed in soils, upon the productivity of the soil.

The studies upon peat were continued. It has been demonstrated that the different varieties of peat show apparently characteristic different decomposition products. This study is extremely difficult and the interpretation of the results obtained is not as yet possible.

A study of the powers of water retention by peat is in progress and so far as it has gone seems to promise extremely important results as affecting the use of peat as a soil amendment.

## FERTILIZER INVESTIGATIONS

The fertilizer work of the Bureau of Chemistry and Soils had a twofold origin. Explorations in search of natural deposits of phosphates, nitrates, and potash-bearing minerals and brines, surveys of known and newly discovered occurrences of these, of the potash-containing kelp beds of our Pacific coast, and of organic wastes, and investigations of methods for the utilization of all these for fertilizer purposes were conducted in the former Bureau of Soils. The problems involved in devising methods and apparatus for the economic fixation of atmospheric nitrogen and studies of related projects, occupied the attention of the Fixed Nitrogen Research Laboratory, originally in the War Department but transferred in 1921 to the Department of Agriculture.

The work has for its purpose making the best use of our many resources—air, minerals, and byproducts—to give the farmer the greatest value for the money he invests in plant food. The solution is complicated, involving national and international commerce and transportation, as well as intricate chemical manufacture. In the past, the United States has been dependent on imports for both nitrogen and potash; fertilizers diluted with inert materials and therefore unnecessarily low in plant food have been too generally accepted with the incident high costs for bagging, handling, and freight; too little care has been exercised in securing uniform mixtures and uniform and properly placed distribution in the field. The trend has been toward correction of these faults, and cheaper and better fertilizers are available as a result.

## NITROGEN

### CATALYSTS IN NITROGEN FERTILIZER INVESTIGATIONS

The development by this Bureau of efficient ammonia catalysts, high-pressure catalytic technic and apparatus, and hydrogen-purification catalysts, made possible this country's general employment of the direct synthetic ammonia process with resultant low fixed-nitrogen prices and self-sufficiency for peace-time industries and national defense. The work was originally mostly empirical in nature and found application also in allied industrial processes.

The investigations have as their purpose the gaining of a fundamental understanding of catalytic phenomena so that the information gained may be applied to the devising of improved catalysts and catalytic procedures for use in the production of fertilizer materials.

Two types of work relating to the kinetics of ammonia synthesis have been in progress during the past year. The dependence of rate of reaction upon the partial pressures of ammonia and hydrogen and upon temperature was determined in the reverse reaction of the decomposition of ammonia on promoted iron catalysts. Also an apparent means for estimating the surface areas of synthetic ammonia catalysts was found as a result of the discovery that the isotherms of a number of different gases at only a few degrees from their boiling points bear a certain relationship to the amount of gas necessary to form a monomolecular layer on the catalyst surface.

Work on the kinetics of the conversion of ortho- to para-hydrogen, mentioned last year, has been completed. In the course of this work it was shown that the adsorption and activation of hydrogen is not the rate-determining step in



ammonia synthesis, that at least two types of activated adsorption of hydrogen occur on iron synthetic ammonia catalysts, in addition to the usual physical adsorption, and that the observed dependence of the rate of the para- to ortho-hydrogen transformations over iron catalysts on temperature and pressure is explainable in terms of the effect of these two factors on the adsorption of hydrogen by the catalysts.

A preliminary study of a method of producing hydrogen for ammonia synthesis by oxidizing phosphorus vapor with carbon dioxide to form phosphorus pentoxide and carbon monoxide, and then converting the carbon monoxide with steam into hydrogen and carbon dioxide, definitely showed the possibility of carrying out the first step of the procedure and that this reaction involves an equilibrium in the temperature range 800° to 1,000° C.

In the study of the "work function", that is a measure of the heat of vaporization of electrons from catalytic surfaces by the photoelectrical method, it was discovered that activated, adsorbed gases have a pronounced effect in lowering the energy of the escaping electrons. These experimental results fit in very well with recent theories of surfaces and indicate that in one form of adsorption the dissolved gas approaches an ionized state.

#### PHYSICAL CONSTANTS OF GASES AND FERTILIZER SALTS

Although concerned largely with fundamental studies of the reactions involved in nitrogen-fixation processes and the formation of fertilizer compounds, the Division of Physics and Physical Chemistry meets a constant demand for cooperative work from other divisions of the Bureau as well as from other bureaus of the Department of Agriculture by assisting them with X-ray, crystallographic, spectroanalytical, photochemical, high temperature and pressure, mathematical, and statistical problems. The solution of numerous problems confronting scientific investigators depends on a knowledge of the physical constants and ultimate structure of the elementary substances and compounds involved. The use of modern physical and physicochemical research methods in the furtherance of fertilizer and other agricultural investigations constitutes pioneer work in a field filled with incalculable possibilities.

In studying the vapor contents of compressed gases that are in contact with liquids, composition and compressibility measurements on both the liquid and gaseous phases of ammonia-hydrogen mixtures were made during the year at 100° under total pressures up to 800 atmospheres. The work on the solubility of hydrogen in liquid ammonia reported last year has been extended to the determination of the solubility of helium in water at 0°, 25°, and 50° under pressures up to 1,000 atmospheres, in order to obtain a better understanding of the nature of the solubility of gases in liquids. In addition, measurements were made of the solubility of a 3:1 hydrogen-nitrogen mixture in water at 25° under pressures ranging from 50 to 1,000 atmospheres. A closely additive relationship was found.

To further our knowledge of the thermal properties at high temperatures of substances important in fertilizer production, an apparatus has been constructed capable of measuring vapor pressures at temperatures up to 1,000°, and measurements have been made therewith of the vapor pressures of phosphorus pentoxide at 200° to 600° over three solid phases, the metastable, glassy, and crystalline, and over the liquid phase.

In continuation of the work on the physical examination of fertilizer materials by X-ray diffraction analysis reported last year, the various acid phosphates and their hydrates have been prepared in pure form and their crystallographic and optical constants measured. Partial isomorphism was found to exist between gypsum and dicalcium phosphate dihydrate. Routine examinations were also carried out on soil colloids, fertilizer mixtures, and products obtained in experimental work. In addition an extensive study was conducted on a number of oxalates, selected as representative organic compounds, to show the correlation between crystal optics and crystal structure. This work showed that the oxalate group is invariant in shape and that the high optical anisotropy of oxalates is completely explained by the orientation of the group in the crystals. The use of electron diffraction as a method of analysis disclosed that the phosphorus molecule in the gas phase at 200° is a regular tetrahedron.

The Bureau's recent work upon the absorption spectra of ozone and the nitrogen oxides has suggested the probable importance to agriculture of

chemically active trace constituents of the atmosphere, a field which merits careful study. During this year's work upon the absorption of light by nitrogen trioxide there was discovered a band spectrum due to nitrous acid, which furnished a means for determining this substance in gaseous systems. Having this spectrum, an almost complete control is afforded for the complicated and economically important system, consisting of nitric oxide, nitrogen dioxide, water, nitrous acid, and nitric acid, involved in the production of nitric acid. A study was also made of the effect of pressure upon the absorption spectrum of nitric oxide and a theoretical explanation of the cause of this phenomenon has been deduced. Infrared absorption coefficients were determined for more than 50 organic compounds containing the groups  $\text{NH}_2$ ,  $\text{NH}$ , and  $\text{OH}$ , the results being particularly important because they provide a method of quantitative analysis for these groups in molecules that are soluble in nonpolar solvents.

By use of the mass spectrophotograph mentioned in last year's report, it was found that the atomic weights of lithium, potassium, and rubidium can be determined with an accuracy far greater than by chemical means. The isotope ratios of potassium have been measured for a large number of mineral, plant, and animal sources, and found fairly constant in minerals but not at all so in plants and animals, kelp and bone marrow, for example, having a pronounced ability to concentrate the heavier radioactive isotope. The investigation is being extended to determine the physiological significance of this preferential selection by certain plants and animal organs of one potassium isotope over another.

#### NITROGENOUS FERTILIZER MATERIALS

Although the development of the nitrogen-fixation processes with the resultant abundance of nitrogen compounds, as well as increased consumption of organic ammoniates in animal feeds, have caused considerable displacement of the use of these ammoniates for fertilizers, demand for them still remains strong despite a price per unit of nitrogen greatly exceeding that of inorganic materials, because of their resistance to leaching, action as conditioners in mixed fertilizers, slight tendency to increase soil acidity, and slow rate of availability. Among the products obtained by the Bureau in an endeavor to produce from organic materials of little or no value a cheap fertilizer material that possesses these desirable properties, those obtained by the ammoniation of peat give most promise of serving as substitutes for the expensive organic ammoniates.

Continuing the previously reported work on the ammoniation of peat, a study was made to determine differences in the products obtained as a result of changes in temperature, pressure, moisture present, and ratio of ammonia to peat in the ammoniation process. Increasing the ratio of ammonia, pressure, and moisture produces a material of better quality but increasing the temperature raises the proportion of inactive nitrogen in the product. The value of the products has been judged from pot and nitrification tests and from permanganate methods for determining activity. The results obtained have not all been favorable but indicate that under certain conditions of preparation or use the ammoniated material is a suitable fertilizer material. Treatment of peat with alkalies, acids, and steam has been carried out prior to ammoniation with a view to obtaining products in which the insoluble nitrogen was highly active. The results obtained have not been very uniform although some improvement in activity has been achieved, but marked improvement has been noted in some cases in which the ammoniated product has been thus treated. Activities of the insoluble nitrogen have been raised in instances from about 50 to more than 90 percent as indicated by the neutral potassium permanganate test. Verification of the value of the nitrogen for plant growth remains to be tested by nitrification and vegetative tests.

A comprehensive study of the mechanism of the formation of the water-soluble nitrogenous constituents of the ammoniated peat has been made. The data obtained show that the organic acids of the peat combine with the ammonia to form ammonium salts which, upon continuation of the ammoniating process, are transformed into urea and into other amides. The desirability of increasing the potential organic acid content of peat to a maximum before ammoniation is thus indicated.

Among several double salts of urea that have been prepared during the past year, one of promising fertilizing utility is a combination of urea with magnesium sulphate. The properties of this compound are being investigated. Difficulties encountered in determining accurately the urea content of such



salts during the course of the work have led to the development of an improved analytical procedure for this purpose. Although a number of double compounds of ammonia have been formed by treatment of inorganic nitrogen carriers and compounds with liquid ammonia, none of these was found to be suited for fertilizer use because of the high vapor pressure of the ammonia contained in them. The possibility of producing more stable compounds of this type is still under investigation.

#### BIOCHEMICAL AND ORGANIC NITROGEN INVESTIGATIONS

Our investigations during the year have shown that *Azotobacter* is able to produce ammonia from a large number of nitrogenous compounds, including proteins, amino acids, nucleic acids, and simple and substituted amides, and also from its own cell nitrogen and that the ammonification takes place under aerobic and anaerobic conditions though to a smaller extent in the latter case. Various intracellular enzymes have been identified, including urease, arginase, adenase, and guanase, and a number of the intermediate compounds formed in ammonification have been determined in certain important cases. The influence of various factors such as added carbohydrate, toluene, cyanide, hydrogen-ion concentration, and gas phase have been studied. As a result of these studies it may be concluded that the ammonia production reported by previous investigators was derived from cell nitrogen and not by direct synthesis from nitrogen gas as they had supposed.

The influence of high temperatures upon the growth of *Azotobacter* in free nitrogen and on various fixed-nitrogen compounds was also studied and the growth velocities at both suboptimal and optimal temperatures found to occur in the increasing order: nitrite, nitrate, free nitrogen, ammonia, urea, and glutamate. At temperatures above optimum, the relations are somewhat altered. In general the cultures in free nitrogen behave, over the entire temperature range, more nearly like those using reduced nitrogen compounds such as urea and ammonia than like those supplied with oxidized compounds like nitrite or nitrate. These results indicate strongly that nitrogen fixation is a reduction and not an oxidation process. Other data obtained, dealing with the catalytic effect of molybdenum on the fixation process, indicate that an amide compound may occur as an intermediate in nitrogen fixation.

During the year work was started on a study of cell oxidation as it occurs in legume nodule bacteria as a continuation of the research which recently resulted in the discovery of an accessory substance essential for the respiration and growth of certain species of these organisms. Preparations of the growth substance, considerably more concentrated than those obtained previously from sugar and molasses, have been obtained by taking advantage of the fact that it is synthesized by *Azotobacter*. Fractional electrolysis experiments showed that the growth factor has many properties in common with pantothenic acid, a constituent of the "bios" complex, but is not identical with it.

The Bureau's studies dealing with leguminous plants serve to emphasize the importance of carbohydrate supply in nodulation and nitrogen fixation and in the maintenance of a healthy condition. The harmful effects of high concentrations of fixed nitrogen on nodule development can be overcome partially by increasing the rate of photosynthesis. Contrary to the view of many research workers, it is now fairly certain that the bulk of the energy supply is not consumed in the chemical process of nitrogen fixation but is utilized chiefly for the respiration and growth of the bacteria and host. Results that were obtained in work on the effect of older plants on the production of nodules on young seedlings indicate that the favorable effect of such older plants is of negligible benefit to the farmer.

Considerable work was done during the year in an effort to determine the life cycle of a nitrogen-fixing blue-green alga that has been isolated from the soil. It has been shown to be probably a species of *Nostoc* although having many characteristics in common with *Anabaena*. Studies of the various stages of its growth indicate that much of the soluble nitrogen which it often liberates into the medium represents portions of the original cells liberated in the normal growth of the organism. This liberation of available nitrogen is undoubtedly a factor of considerable economic importance in nature.

In a study of the behavior of active nitrogen with organic compounds a comprehensive investigation was made of its reaction with diphenylacetylene. Excellent yields of a nitrogenated organic material, having the approximate empirical formula  $(C_{12}H_{11}N_3)_x$ , were obtained when optimum conditions were

approached. The general mechanism of the reaction has been determined and it has been shown that the fixation is produced by excited molecular nitrogen. This work of the Bureau clearly demonstrates for the first time that such nitrogen will react with organic substances, and it is the first case in which nitrogen has been fixed directly by an organic compound apart from living processes. Although this reaction has little practical significance it is of importance theoretically since it serves as a foundation for anticipating the introduction of nitrogen of a much lower energy content into organic compounds.

When *Azotobacter vinelandii* was grown in a medium containing urea as a source of nitrogen, progressive morphological changes occurred, and the sucrose, which was used as a source of energy, was extensively hydrolyzed, a strikingly different behavior than that exhibited by the bacteria when grown in media in which atmospheric nitrogen was the only source of nitrogen. A sugar-hydrolyzing enzyme isolated from the bacteria under both conditions was found to be quite similar, hydrolyzing not only sucrose but also maltose, raffinose, and alpha-methylglucoside, but not melizitose. Optimum hydrolyzing power was exhibited at a lower hydrogen-ion concentration than for yeast invertase (pH about 6.8 compared with 4.7). When the *Azotobacter* was grown on fructose instead of sucrose, none of the enzyme was manufactured by the bacteria.

### POTASH

The termination last year of the potash-phosphate blast-furnace project of the Bureau, left behind collateral projects of fundamental importance such as the most feasible utilization, chemically and economically, of the products potassium chloride and phosphoric acid. Their combination to produce potassium metaphosphate with byproduct hydrochloric acid appeared to be of first importance.

A study of processes for the production of potassium metaphosphate, a compound of 100-percent plant-food content, from potassium chloride and phosphoric acid showed that a two-stage procedure, the first conducted at 200° C. with the introduction of steam and the second at 540° without the use of steam, gives a product which when ammoniated can be used directly as a concentrated fertilizer.

Recent developments in the cement industry, based on earlier investigations of the Bureau, have made possible the large-scale production of byproduct potash as fume from cement kilns. This is separated from the dust by means of multi-cones, then humidified, and finally subjected to electrical precipitation. The Bureau's work has shown that the product may be subjected to various treatments such as simple extraction with water, neutralization with oxides of nitrogen or extraction with ammonia and carbon dioxide in aqueous solution to yield higher grade fertilizer materials.

Since hydrochloric acid is a byproduct of many processes for the conversion of potassium chloride into other potash salts, such as potassium nitrate, sulphate, and metaphosphate, studies have been conducted of methods for its utilization. When used for the treatment of phosphate rock, it was found that the major portion thereof can be recovered for re-use and that a hitherto unknown salt, calcium phosphate-chloride can be formed. The properties of this new compound indicate that it is a suitable fertilizer material in itself. It may also be used for the preparation of dicalcium phosphate and calcium pyrophosphate.

In a continuation of the study of the extraction of potash from silicates by hydrochloric acid an improved procedure was designed wherein the dissolved salts obtained are precipitated with gaseous hydrochloric acid instead of by vaporization, the precipitated salts being then selectively hydrolyzed for the separation of the potash and alumina as high-grade products. The past year has seen the completion of the work on the solubility of alunite in various commercial solvents. The data obtained indicate the possibility of the use of either potassium or sodium hydroxide to extract both the potash and the alumina from previously roasted alunite.

The drastic reduction in the prices of fertilizer-potash salts that has occurred within the year has altered the economic prospects of chemical processes developed or under development for the extraction of potash from the potassium aluminum silicates long regarded as potential sources of potash. In consequence, future research aiming at the utilization of the potash silicates



must necessarily be restricted to processes yielding the potash either as a by-product or as a constituent of fertilizer materials that also contain one or both of the other fertilizer essentials, nitrogen and phosphoric acid.

### PHOSPHATES

Further work on the process for preparing phosphate fertilizer by calcining silica-bearing phosphate rock at 1,400° C. in the presence of water vapor has shown that Tennessee brown-rock phosphate is somewhat better adapted to the manufacture of calcined phosphate than are the other types of domestic phosphate rock; that for the best results the silica should be present in a comparatively fine state of division and should be thoroughly dispersed throughout the phosphate particles; and that phosphate rock that has been concentrated by flotation methods can be used directly (without further crushing or grinding) in the manufacture of calcined phosphate. Vegetative pot tests, in cooperation with the Bureau of Plant Industry and the Alabama, Arkansas, and West Virginia Agricultural Experiment Stations showed that properly prepared calcined phosphate is as good (frequently better) a source of phosphorus for plant growth as is either superphosphate or dicalcium phosphate. The reactions involved in the preparation of calcined phosphate constitute an entirely new field of phosphate chemistry which it is believed will have far-reaching effect on the future phosphate fertilizer industry and practice in this country. The process has attracted wide-spread interest in the fertilizer and phosphate-rock industries.

During the year considerable work has been done on the composition, chemistry, and properties of ordinary superphosphate and double or triple superphosphate. In this connection, studies were made of (1) the nature and interrelationships of the free acids in fresh and in cured superphosphates, (2) the solubilities of the superphosphate components in water and in neutral ammonium-citrate solution, with special reference to the changes occurring during the aging of superphosphate, and (3) the occurrence and identification in superphosphate of dicalcium phosphate, hydrated and anhydrous monocalcium phosphate, and the different hydrates of calcium sulphate. The information obtained in these studies is of primary importance in the preparation of superphosphates and complete fertilizer mixtures having good mechanical condition and satisfactory storing and drilling qualities. The crop-producing efficiency of a given fertilizer depends to a considerable extent on the mechanical condition and the uniformity with which the fertilizer can be distributed in the field.

Waste sulphuric acid from the refining of petroleum is available in considerable quantity in certain sections of the country, and under certain conditions it can be used economically in the manufacture of superphosphate. With these facts in view an investigation has been started to determine whether superphosphate prepared with waste sulphuric acid from the refining of petroleum, contains substances harmful to plants and to the nitrifying organisms of the soil.

Studies have been made on the preparation of tetracalcium phosphate and on the behavior of tricalcium phosphate and hydroxyapatite at high temperatures in the presence and absence of silica and in both dry and moist furnace atmospheres. All these compounds are involved in the reactions occurring in the preparation of phosphate fertilizers by heating silica-bearing phosphate rock in the presence of water vapor.

Important findings by the Bureau in regard to the toxic effects of selenium in certain soils have led to a study of the selenium content of domestic phosphate rock. This study showed that the largest quantities of selenium (up to 55 parts per million) occur in phosphate rock from certain deposits in the West. The Florida and Tennessee phosphates were found to contain little or no selenium.

A comprehensive report, which will give a detailed account of the recently concluded experimental work of the Bureau on blast-furnace smelting methods as applied to phosphate and potash rocks, is now in course of preparation.

### MIXED FERTILIZER TECHNOLOGY

A study of the effects of particle size on the drillability and efficiency of fertilizers has been completed. The results indicate that finer than 80-mesh particles of superphosphate are more efficient for growing cotton in the soils

used than are coarser particles. On the contrary, large particles of readily soluble nitrogenous materials are better than fine powders of the same materials. Grained mixed fertilizers were most efficient when of 80- to 150-mesh particle size. Drillability tests showed that caking takes place more readily in fertilizers consisting of fine-sized particles and that segregation in mixed fertilizers is due largely to differences in particle size of the different components. A segregating mixture can often be rendered nonsegregating by regrounding the entire mixture a little finer. Nitrogen, potash, and total soluble salts were found to be removed by natural agencies from the placement area in the soil, and thus out of reach of the roots of the plants, in greater proportion as the size of the particles diminished, the nitrogen disappearing relatively much more rapidly. Decrease in size of superphosphate particles was accompanied by greater reversion of phosphoric acid to insoluble forms.

An investigation of the effect of urea and other admixed salts on the hygroscopicity of calcined phosphate disclosed that the mixtures were in every case less hygroscopic than corresponding mixtures containing ordinary superphosphate. Such fertilizer mixtures will, therefore, be less likely to absorb moisture and become damp and to lump and cake than the corresponding mixtures containing ordinary superphosphates.

The effect of the increased temperatures produced when superphosphate mixtures are ammoniated with urea-ammonia solution on the decomposition of the urea has been studied further. In the course of the investigation the hydrolysis products of pure urea, urea phosphate, and mixtures of urea with the various components of ordinary and double superphosphates were determined, and it was found that in many cases the urea was destroyed with a loss of ammonia while the orthophosphates present were reduced to pyrophosphates or metaphosphates.

In a study of the reactions of diammonium phosphate with limestone and with dolomite, it was found that all proportions of the materials in mixtures of this kind cause loss of ammonia. Neither limestone nor dolomite should be added to an ammoniated double superphosphate in sufficient quantity to give a physiologically neutral mixture when the ammonia in the ammoniated phosphate exceeds 10 percent. Charts have been drawn from the experimental data that show the maximum quantities of limestone that may be included in various mixtures of ammonium sulphate and ammoniated double superphosphates without causing loss of plant-food value. A study of the use of calcined phosphate in fertilizer mixtures showed that it causes loss of ammonia from ammonium sulphate. This loss of ammonia may be prevented by adding to the mixture one part of superphosphate per part of calcined phosphate present.

As a result of the frequent claims made by fertilizer chemists that the official method gives low results for water-soluble potash in mixed fertilizers, an investigation was undertaken of the cause of these low results and of the extent to which a loss of potash takes place. It was shown that the low results are limited to mixtures containing superphosphate and that they are due to occlusion or adsorption of a small portion of the potash in the basic iron and aluminum phosphates formed in the extraction of the sample. The loss varies with the iron and aluminum content of the phosphatic materials used in the manufacture of the superphosphate and is greater in mixtures of superphosphate with potassium sulphate than in the corresponding mixtures with potassium chloride. The loss increases within limits with the age of the mixture, and it is greater when the potash salt is mixed with a cured superphosphate than when mixed with a fresh superphosphate. It was also found that the loss in the average mixed fertilizer amounts to about 1.5 percent of the total potash present.

The collaborative study of methods for the determination of free acids in superphosphates, mentioned in last years' report, disclosed (1) that the free acid in a sample of monocalcium phosphate may or may not be increased by the addition of moisture, depending on the proportion of free acid to monocalcium phosphate initially present; (2) that the variations in results with the different methods in the analysis of samples having a low ratio of free acid to moisture are greater than in the analysis of samples in which this relationship is reversed; (3) that more concordant results are obtained with the acetone method than with any other method, and that this method gives the closest agreement with the theoretical values; (4) that when the water-extraction method is used to determine free acid in a monocalcium phosphate sample containing dicalcium phosphate as well as free phosphoric acid, the results obtained will be correct.



too high, or too low, depending on whether the solid dicalcium phosphate is unchanged, increased, or decreased in the process of extraction; and (5) that an extraction method cannot be used as a measure of the physiological acidity arising from the free acid in a superphosphate.

The results of the work done on the use of filler in fertilizer mixtures and showing the changes in composition and physiological acidity of fertilizers from 1880 to 1932, also mentioned in last year's report, elicited wide-spread interest. The National Fertilizer Association offered to cooperate in making a further study of statistics for the fiscal year ended June 30, 1934. This offer was accepted, and a large amount of information is being collected on the number of grades and kinds of fertilizer consumed in each State. When finished this work will show what progress has been made since 1932 in eliminating filler from mixed fertilizers and how many unnecessary grades of fertilizer are being manufactured. Neither filler nor large numbers of similar grades add anything of value to our economic scheme but increase the cost of fertilizer to the consumer.

The economy in the use of higher analysis fertilizers and the elimination of filler has been worked out from the price schedules submitted by fertilizer manufacturers to the code authority. This work shows that the use of double-strength mixtures at the prices actually being quoted will save the farmer about 20 percent of his fertilizer bill. Cutting the wholesale prices of nitrogen, phosphoric acid, and potash in half would not save as much money for the farmer as would result from simply leaving out the sand and other useless filler now being used in certain sections of the country in the preparation of mixed fertilizers.

### INFORMATIONAL AND EDITORIAL SERVICE

The 54 new departmental publications from this Bureau printed in the past fiscal year include 26 soil-survey reports, 7 technical bulletins, 3 circulars, 3 miscellaneous publications, 5 articles in the *Journal of Agricultural Research*, and 10 articles in the 1935 *Yearbook of Agriculture*.

Final editing of the page proofs of *Soils of the United States*, part 3 of the Department's *Atlas of American Agriculture*, prepared by Curtis F. Marbut, Chief of the Division of Soil Survey, was completed during the fiscal year, and advance copies came off the press in July 1935. The map and description of the soils of this country contained in this publication furnish the first complete inventory of the basic agricultural resources of an entire nation ever printed. Over 6,000 soil types which have been recognized and mapped in all parts of the United States by the Division of Soil Survey have been combined in this atlas into the 250 important groups of soils which form the first detailed map of a great continental area. The publication contains more than a hundred chemical and mechanical analyses of important soil types which are of great value in determining the agricultural values and potentialities of typical soils in the basic regional areas of agriculture. The description of the genesis and the classification and mapping of such great regional soil groups as the Podzols, Chernozems, Prairie soils, Red and Yellow soils, and the Gray-Brown Podzolics, contained in this volume, are of special interest to soil scientists and have great practical value for regional planning of agriculture.

In addition to the official publications listed below, more than 140 articles on various phases of the Bureau's work have been published in journals and periodicals during the past fiscal year. These articles have, for the most part, supplied technical information of value to scientists and, in other cases, have interpreted to farmers and the general public important phases of the Bureau's work. In cooperation with the Press Service of the Department, the Bureau has furnished newspapers with timely information on practical problems of agriculture and utilization of farm products.

## PUBLICATIONS OF THE BUREAU OF CHEMISTRY AND SOILS ISSUED DURING THE YEAR JULY 1, 1934, TO JUNE 30, 1935

### TECHNICAL BULLETINS

- No. 426. Relation of Fertilizers to the Control of Cotton Root Rot in Texas.  
 No. 430. Further Studies of the Physical and Chemical Characteristics of the Soils from the Erosion Experiment Stations—Second Report.  
 No. 449. Storage of Mill Cane. (Joint publication with the Bureau of Plant Industry.)  
 No. 452. Experiments with Nitrogen Fertilizers on Cotton Soils.  
 No. 461. Base Exchange and Related Properties of the Colloids of Soils from the Erosion Experiment Stations.  
 No. 469. A Method of Rural Land Classification.  
 No. 471. Chemical Studies of Infertile Soils Derived from Rocks High in Magnesium and Generally High in Chromium and Nickel.

### CIRCULARS

- No. 319. Fertilizer Studies with Sugar Beets in the Arkansas Valley Area, Colo. 1921-28. (Joint publication with the Bureau of Plant Industry.)  
 No. 320. Report on a Preliminary Field Survey of the So-called "Alkali Disease" of Livestock. (Joint publication with the Bureau of Plant Industry.)  
 No. 329. Manufacture, Composition, and Utilization of Dairy Byproducts for Feed.

### MISCELLANEOUS PUBLICATIONS

- No. 192. A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on Its Occurrence and Uses.  
 No. 206. The Naval Stores Station of the Bureau of Chemistry and Soils.  
 No. 221. Soil Blowing and Dust Storms.

### JOURNAL OF AGRICULTURAL RESEARCH ARTICLES

- The Occurrence of Ferrous Iron in Phosphate Rock.  
 The Cystine, Tryptophane and Tyrosine Content of the Soybean.  
 Oil Retention, Oil-Emulsifier Ratio and Oil-Water Ratio as Affecting the Insecticidal Efficiency of Emulsions. (Joint publication with the Bureau of Entomology and Plant Quarantine.)

Nitrogen Fixation Studies with Fungi and Actinomycetes.  
 The Thermophilic Fermentation of Beet Pulp.

### SOIL SURVEYS

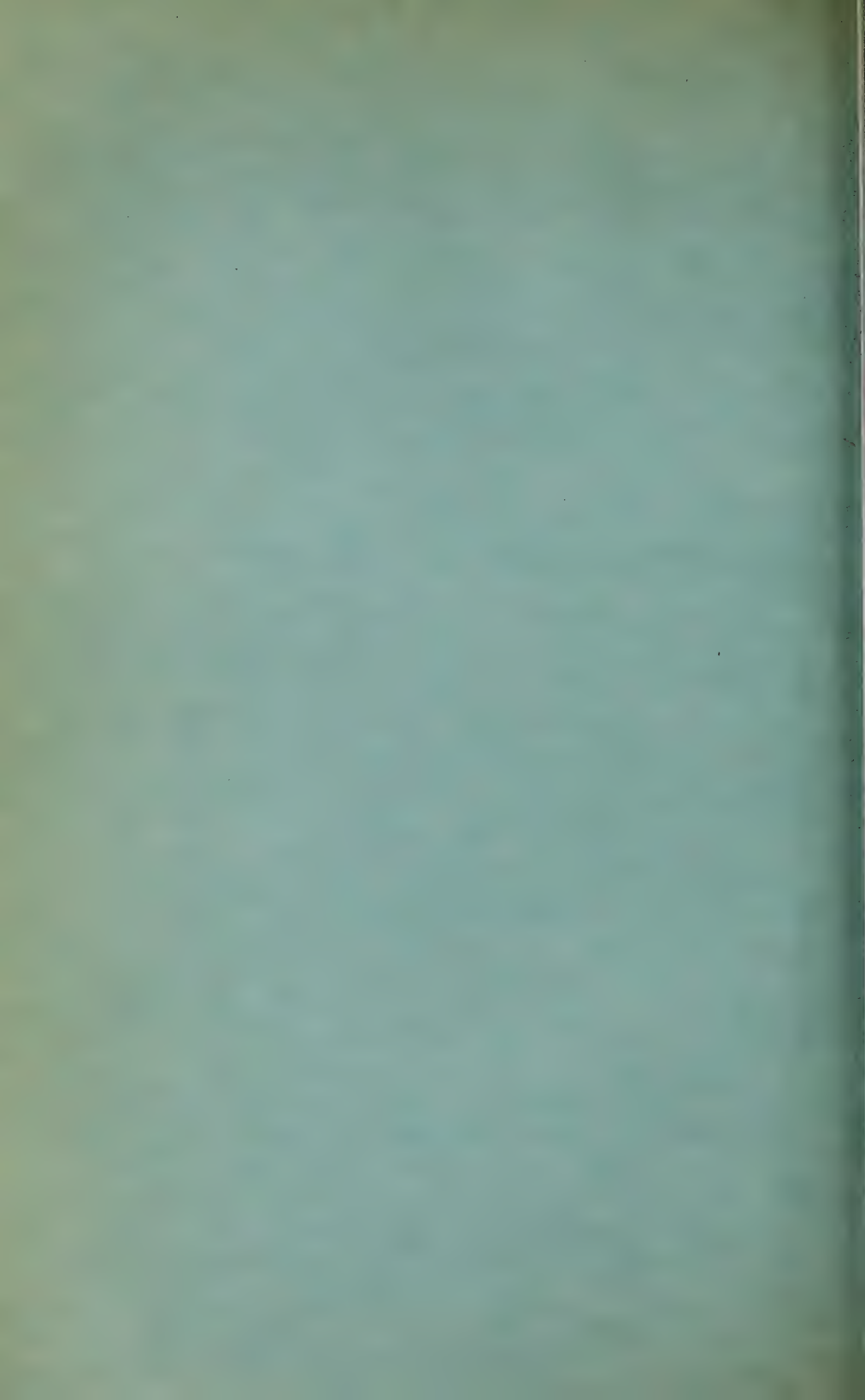
Hennepin County, Minn.  
 Reconnaissance of the Trans-Pecos Area, Tex.  
 Vermillion County, Ind.  
 Poweshiek County, Iowa.  
 Collin County, Tex.  
 Houston County, Minn.  
 Tioga County, Pa.  
 Potter County, Tex.  
 Benewah County, Idaho.  
 Tillman County, Okla.  
 Sherman County, Nebr.  
 Jefferson County, Ga.  
 Mercer County, Ky.  
 St. Clair County, Mich.  
 Frio County, Tex.  
 Furnas County, Nebr.  
 Reconnaissance of the Columbia Basin Area, Wash.  
 Galveston County, Tex.  
 Alger County, Mich.  
 Rockbridge County, Va.  
 Wyoming County, Pa.  
 Washtenaw County, Mich.  
 Bay County, Mich.  
 Columbia County, Oreg.  
 Knox County, Nebr.  
 Dixon Area, Calif.

### YEARBOOK ARTICLES

Citrus Byproduct Uses May Greatly Influence Fresh-Fruit Market.  
 Composts Are Good Means of Improving Soil of Small Farms.  
 Fruit Darkening Can Be Prevented by New Process.  
 Nitrogen Balance Sheet Shows Annual Deficit Requiring Replacement.  
 Phosphate Blast Furnace Is Nucleus for Balanced Fertilizer Trade in West.  
 Phosphate Fertilizer Prepared by Treating Phosphate Rock with Steam at High Temperatures.  
 Sirup Buying from Farms by Relief Agency Shows Need for Better Quality.  
 Soil Erosion Studies Develop Information of High Practical Value.  
 Soil Survey Provides Data for Classifying Land; Planning Uses.  
 Starch Making from Cull Sweetpotatoes Is Placed on Commercial Basis.









# REPORT OF THE CHIEF OF THE BUREAU OF DAIRY INDUSTRY, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF DAIRY INDUSTRY,  
Washington, D. C., September 1, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the work of the Bureau of Dairy Industry for the fiscal year ended June 30, 1935.  
Sincerely yours,

O. E. REED, *Chief.*

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Much information has accumulated as a result of research work in the Bureau of Dairy Industry which if practiced more generally would greatly improve the economic position of various branches of the dairy industry.

The farmer's opportunities lie largely in adopting practices to reduce his costs in producing milk and to improve the quality of his product. Opportunities to reduce costs are largely in the development of efficient herds and in following more efficient farming and feeding practices. Producing a high-quality product affords an opportunity for obtaining premium prices as well as indirect benefits that come from the increased consumption associated with high-quality products. The past year has seen some encouraging progress in the wider application of a number of good dairy practices suggested by research information.

The noticeable trend toward more acreage in grass and forage crops and less in cultivated crops is in line with good dairy practice. Bureau studies a few years ago suggested that dairy farmers in many instances would increase the profits from the farm as a whole if they grew most of the feed for milk production in the form of roughage crops rather than in the form of grain crops. Roughage crops as a rule produce the nutrients required for milk production at less cost than the grain crops. To have the maximum benefits, of course, the shift to grass and forage crops must be accompanied by attention to quality of the roughage as well as to quantity. Research has not only explained the importance of certain nutritive essentials that are best supplied by high-quality roughage but it has suggested practices for harvesting, curing, and storing to preserve the nutritive properties of grasses and other roughages.

The cream-quality-improvement campaign inaugurated by the creamery-butter industry, which became national in scope last year, can be attributed to the efforts of dairy research workers who have long pointed out the essential sanitary practices for improving quality, to the efforts of extension forces and other educational workers who demonstrated the practicability of the methods, and to the efforts of Department regulatory officers in seizing and dumping cream and butter found unfit for food. The far-reaching effects of the campaign can hardly be overemphasized. The value of a sanitary food product was never more strikingly demonstrated than by the increase in consumption of milk as its quality improved; the same favorable consumer reaction can reasonably be expected as the quality of the general butter supply is improved. Quality of the butter, of course, depends largely on the quality of the cream. Farmers everywhere are taking increased interest in producing high-quality cream, not only because of the difficulty of disposing of poor-quality cream but because of the premium prices paid for the better quality.

More than 98 farmers out of 100 who milk cows keep no records of production on their individual cows. Without such records the average dairyman can make little or no progress in improving the producing capacity of his cows, by

his own efforts. Improvement in the great mass of our milk-cow population, therefore, will depend on the development of breeding herds from which the average dairyman can obtain the right kind of herd sires. The Bureau has demonstrated the possibility of developing strains or herds of cattle with such a high degree of genetic purity that all the young bulls bred in the herd can be counted on to transmit a high level of production. Progressive dairy farmers and commercial breeders who develop such pure-line production herds will be the ones to furnish the right kind of sires for improving the farm herds. During the year, the Bureau began a comprehensive study to determine what progress has been made in commercial breeding herds, and college and experiment station herds, toward fixing an inheritance for high milk and butterfat production. When all these herds have been analyzed, dairy-cattle breeders should be in a position to make more rapid progress by concentrating the superior germ plasm of outstanding animals and herds.

All the Bureau projects financed from funds allotted by the Public Works Administration were practically completed during the fiscal year. These projects provided 79,686 man-hours of employment during the year, or a total of 304,686 man-hours since the work began in October 1933.

The cooperative arrangements existing between the Bureau and the Grove City Creamery, Grove City, Pa., for about 20 years were brought to a close at the end of the fiscal year. Work formerly carried on at the Grove City Creamery will hereafter be done in the new dairy-products laboratory at Beltsville, which will be ready for occupancy about October 1. The transfer of this phase of the Bureau's research work to Beltsville will effect economies in operating costs and bring the work under closer supervision of the Bureau's technical staff.

Progress in the research work in the Bureau's various laboratories and at its field experiment stations is summarized in the following pages.

## DIVISION OF DAIRY RESEARCH LABORATORIES

L. A. ROGERS, *in charge*

### NUTRITION OF DAIRY COWS

Since the nitrogenous feeds are the most expensive part of the ration of the dairy cow, it is very important that the protein requirements be determined as exactly as possible. While these have been definitely formulated in so-called "standard rations", the data on which these formulas are based have been obtained, for the most part, on short-time feeding tests; and differences of opinion still exist as to the level at which the protein should be maintained in the ration of a milking cow.

To establish this point more definitely a few cows were maintained on a high-protein diet for an entire lactation period, followed by a low-protein diet for an equal period. The results are striking and decisive. Although the low-protein diet was within the limits of some of the feeding standards, milk yield was depressed in some cases to one-half of the normal. Not only was the total volume of milk very low, but the fat content was below that of the milk produced on a high-protein ration.

Some details of this experiment indicate that this effect is due to a definite limitation of some particular constituent of the protein. If this assumption is correct, it becomes increasingly evident that the protein requirements should be based, not on the crude protein, but on the individual amino acids making up the proteins. Before this can be even approximated a vast amount of work must be done on the structure of amino acids, the changes involved in their conversion from the protein of the feed to the protein of the milk, and on the amino acid complexes of the proteins of various feeds. Work on this problem is progressing as rapidly as possible with the limited force available. A number of highly technical papers have been published in the past year on the chemistry and metabolism of cystine, cysteine, and related compounds.

Data gradually accumulating, on the effect of the quality of the ration on the reproductive function of the cow, continue to show the close relation between the carotene content of the ration and the delivery of normal calves. Excluding infection by the abortus organism, the chance of a cow producing a healthy calf at the normal term appears to be directly proportional to the amount of carotene in the ration. On rations very poor in carotene but still within the limits of dairy practice this chance becomes zero.



The ability of the cow to store carotene while on summer pasture in amounts sufficient to offset the deficiencies of a poor ration is still under investigation. The results obtained, while insufficient to warrant definite conclusions, tend to show that this storage of carotene in the body is not sufficient to counteract the effects of a lack of carotene in the poorer winter rations. There is also some evidence, particularly with rabbits and rats, indicating that the effects of a continued, but slight, vitamin A deficiency may not be evident until the second or third generation.

Additional information has been obtained on the vitamin A requirements of young animals, and the relation of vitamin A to the carotene content of the feed. All of this indicates, quite conclusively, that young calves require whole milk after the colostrum period only as a source of vitamin A. Milk from cows fed on a ration containing sufficient carotene furnishes all of the vitamin A required for normal growth, but this vitamin can be supplied by substituting a small amount of cod-liver oil for the butterfat. Under some circumstances this may be an economical procedure.

The results show more fully than heretofore that, for any given breed of cows, there tends to be a close parallelism between the carotene content of the feed and the yellow color and vitamin A content of the milk and butter. Other points of interest are that the tendency of pasture to give a high yellow color and vitamin A content to butter depends greatly on the season and rainfall. Spring and fall pasture, when rainfall is normal for the locality of Beltsville, are more effective than any ration so far tried. But summer pasture with a rainfall 65 percent of normal is less effective than a ration containing 20 pounds of yellow carrots daily. Carrots, because of their high carotene content, are more effective pound for pound than average No. 1 alfalfa hay.

It is not only important that hay be harvested in such a manner that a maximum carotene content is obtained, but results obtained in the past year indicate that the conditions of storage may be equally important. Hay stored where the temperature is excessively high may lose more than 20 percent of its carotene per month.

Preliminary experiments, confined for the most part to rats and rabbits, indicate that the vitamin G content of hay may be, like vitamin A, in proportion to its quality. Rats on a ration deficient in vitamin G cease to grow and eventually lose all their hair. If this ration is supplemented with good hay, growth becomes normal and the hair grows again. Incidentally, these investigations have shown that cod-liver oil cannot be used as a source of vitamin A for rabbits. This oil contains something toxic for rabbits which is not present in vegetable oils such as cottonseed oil.

#### BACTERIOLOGY AND CHEMISTRY OF MILK

The investigation into the factors which control the germination and viability of bacterial spores has been continued in the hope that some means of destroying all spores with a minimum effect on the substrate in which they are held could be found. While the physiological functions of spores is somewhat comparable to that of seeds of the higher plants there seems to be little relation between the effects of various physical and chemical agents on spores and on seeds. Chemicals which stimulate germination in seeds are without effect on spores. This is also true for those bands of the visible light rays which have a marked effect on the germination of seeds.

A survey of the effect of various parts of the spectrum indicates that the only bands having an appreciable effect on bacterial spores are in the ultraviolet. The effect of this band is markedly lethal and no growth-stimulating effect has been detected. The results obtained in the past year have shown that by certain arrangements of the apparatus a greatly increased killing effect can be obtained. Under the most effective combination yet found complete sterility has not been obtained; but in a suspension containing hundreds of thousands of resistant spores, those living after 30 seconds of exposure have been reduced to an insignificant number. The spores that survive are not killed by a longer exposure but evidently are in a condition that makes them unusually resistant to unfavorable conditions. These experiments throw some light on the mechanism by which the lethal effect of ultraviolet light is produced. No effect either stimulating or lethal could be obtained by supersonic waves.

Notwithstanding the very large amount of work that has been done on the chemistry of milk, the exact nature of many of the combinations of the ele-

ments known to occur in milk is still a matter for speculation. This is true even of the mineral elements which are, presumably, the simpler constituents. The exact nature of the combinations into which these elements enter is a matter of considerable importance because upon them the physical properties of the milk in a large measure rest. This is especially true of calcium on which the casein depends for the maintenance of its colloidal condition and a method of determining the calcium-ion concentration would be of great value in studying the heat stability and other reactions of milk. Work has been done on this problem as time and opportunity permitted and some time ago a calculation, based on purely theoretical grounds, was made of the calcium-ion concentration of milk. In the past year a method has appeared that has made it possible to check experimentally the results obtained mathematically and a satisfactory agreement has been secured.

Phospholipides are fatty substances of very complex chemical nature, containing phosphorus. They occur in small amounts in milk, and because of their phosphorus and fatty acid content and their presence in the blood and milk, were thought at one time to be intermediates in the process of fat secretion. Although present in milk in small quantities, they are undoubtedly an important factor in the stabilization of the fat emulsion. Being of a fatty nature they are to some extent isolated with the natural fats when the fat contents of milk or milk products are determined. The extent to which they are removed depends on the method used. The magnitude of the errors introduced by the removal of these substances is still in doubt, since no method is available for their exact quantitative determination.

Work is in progress to determine what errors the presence of phospholipides may introduce into the various fat tests now in use in the dairy industry. Since quantitative isolation methods are not available for their determination, it is evident that their quantities must be measured through a determination of the quantity of one of their constituents, namely, phosphorus. This method assumes, however, a knowledge of the molecular weight—or what percentage of the molecule is phosphorus. This is not known in the case of milk phospholipides.

In view of this situation a thorough investigation of the constitution and physical characteristics of these phospholipides was undertaken. A study of the solubilities of various fractions of phospholipide material isolated from butter-milk indicates that alcohol-ether mixtures are not necessarily the best solvents to use. On the basis of this information an extraction method has been devised, using chloroform, which insures complete removal of fatty materials without contamination from inorganic phosphorus. Since the amount of phosphorus in any sample is small, it is necessary to resort to the use of micro-methods in its determination. Various methods for the digestion of samples containing considerable quantities of fat have been studied and those suitable for the determination discovered. Knowing the phosphorus content, it is also necessary to know the average molecular weight in order to calculate the amount of phospholipides in any sample. The molecular constituents of milk phospholipides have never been determined, hence a study of these was initiated. This work is nearing completion. When this information is available, a quantitative study of the phospholipide content of any milk product can be made. The phosphorus content of the lipides from various milk products has been determined by the methods outlined and the percentage content may be calculated as soon as work on the chemical constituents has been completed.

A defect in market milk, usually described as oxidized or metallic flavor, has given milk dealers much trouble in the last few years. While this seems to be of recent development it is probable that it has always existed and has become more noticeable in recent years because, through improved methods of handling milk, other defects which masked the oxidized flavor have been removed. It seems to be irregular in its occurrence, but is usually more noticeable when cows are on dry feed and in some cases is strong enough seriously to impair the value of the milk for direct consumption. Work has been done on the chemical reactions causing the off flavor, the treatment of the milk to prevent or remove the flavor, and the possible relation of the feed to the tendency of the milk to become oxidized. Some positive results have been obtained on the first two parts of the problem but, on account of the lack of available animals, nothing definite has been secured on the effect of feed.



## BYPRODUCTS

The possibility of developing industrial products from casein, which would thus increase the demand for it, has warranted a continuation of the investigation on solvents and fractionation. One of the requisites for the utilization of casein in manufacturing processes is a reagent in which it is readily soluble. None of the large number of possible solvents has proved to be better than those already known. Several methods have been devised for splitting the casein molecule but none of the fractions obtained have shown properties which indicate that they would be more useful than the original casein.

Evidence of an interest on the part of the industry in a continuous process for making lactic acid by fermentation of whey, which was announced by this laboratory several years ago, has stimulated studies on the separation of lactic acid from its solution in the fermented whey and on the conversion of lactic acid into some product of greater value and more extensive use. Three different methods are being tried for the purification of the acid and they give some promise of success. A number of new compounds have been made from lactic acid, but none of them gives any promise of having a commercial use.

The problem of utilizing the albumin of whey has been attacked from several angles. An attempt has been made to obtain a reversible precipitate so that the protein could be obtained in a reasonably pure condition, with its physical properties unimpaired. This method has been partly successful, but the yields have been so low that it does not yet have commercial possibilities.

The cream obtained when cheese whey is centrifugally separated has been found to have properties which may be utilized for special purposes. While it has the flavor and appearance of ordinary cream it contains at most only a small amount of casein. For this reason, cream with a high fat content can be sterilized without the formation of an objectionable curd and with a minimum of cooked flavor. The high albumin content gives it especially good whipping quality and it is possible that this property may be utilized to give it an increased value. The use of these products in certain foods is being actively investigated.

One of the impediments in the way of a wider use of dried skim milk for household purposes has been the lack of an inexpensive container that can be shipped and stored without permitting absorption of water. Extensive purchases of skim-milk powder by the Government for relief purposes have made an opportunity for testing paper bags of various types. This work, done in cooperation with some of the paper companies, has demonstrated that it is possible to seal skim-milk powder in especially constructed paper bags so that there is only a slight absorption of moisture even under severe temperature and humidity conditions.

## ICE CREAM

The desirable qualities of ice cream are dependent in a large measure on certain of its physical properties, and the manufacturing methods as well as the ingredients are adjusted to obtain this somewhat intangible physical condition. An ice cream may have a satisfactory body or texture, but the component physical properties that determine this texture are still very largely a matter for conjecture.

In attempting to establish a relationship between some of the basic physical properties, the quality of the ice cream, and the methods of manufacture, it has been necessary to establish methods and to design apparatus adapted to exact measurements on ice cream in its frozen condition. The two measurements found to be most useful are the rate of sag of a beam supported at its two ends and the resistance to breaking of a beam when hit by a pendulum. These determinations are made at a constant temperature of  $-10^{\circ}\text{C}$ . and are reproducible within narrow limits. The first determination measures the rate of flow of the frozen cream and has been used to evaluate the effect on the viscosity of overrun, variations in milk fat, variations in gelatin in relation to the milk-fat content, and the effect of homogenization pressure and of aging. The pendulum measures what may be called the toughness of the ice cream. These determinations have shown that the amount of overrun affects the toughness much more than the viscosity. Thus an ice cream with 75-percent overrun will be nearly 50 percent tougher, as measured by the pendulum, than one with 100-percent overrun, while the viscosity is only slightly affected. Increasing the fat content also increases the toughness or cohesion without

much effect on the viscosity. The data so far collected indicate clearly that cohesion and viscosity, as they affect the texture of ice cream, are independent factors.

In the combination of cane sugar and dextrose in sherbets a certain ratio of the two sugars is necessary to avoid crystallization. The exact ratio at which there is the least probability of crystallization has been determined and the results published.

### CHEESE

The work of the past year has been directed almost entirely toward an investigation of the relationship of the physical properties of milk to the physical properties of Swiss cheese and of the relationship of these properties to the grade of the cheese.

This has required the development of new tests or modification of old ones to measure the reactions of milk which could be expected to have an influence on the quality of the cheese. A large number of determinations on the milk of individual cows has revealed wide variations in the nature of the curd produced when the milk is curdled with rennet and in many cases chemical differences which may account for these variations. The milk from the Beltsville herd may be divided into two classes on the basis of the time required for curdling with rennet and the nature of the curd formed as measured by physical tests. The tests usually employed for measuring the firmness of curd formed by rennet were found to have no definite correlation with the quality of the cheese curd, but a modification was made which showed accurately the nature of the cheese curd which could be expected. The time required for a definite amount of rennet to curdle milk under standardized conditions also proved to be a simple test which gives a good indication of the firmness of the curd.

Efforts to show the relation of mastitis to the physical properties of the milk are handicapped by the uncertainty of the diagnosis and an inability to differentiate between acute cases, chronic cases, and the after effects of a case of mastitis from which the cow has recovered. An investigation is now in progress that is expected to show more definitely the changes in the milk which occur with the development of the disease. Work in these laboratories has failed to confirm the conclusions of other investigators to the effect that mastitis causes a lowering of the milk casein content, but a change in the reaction is evident and this in turn produces an increase in the time required for rennet coagulation and a softer curd.

It does not necessarily follow, however, that these changes will have a detrimental effect on the cheese. If milk has a very short curdling time and a very firm curd, the cheese is likely to have a corky body and to rise too slowly in the curing room. Cheese made from milk of this type will be improved if enough soft-curd milk is added to lower the coagulating time. However, the addition of soft-curd milk in amounts less than 20 percent seemed to have little effect. The most noticeable effect of soft-curd milk on the body and texture of the cheese is an increase in the water content, a softer curd, as measured by a penetrometer, or by its resistance to forcing through a small orifice, and a greater elasticity. The elasticity may be measured by determining the resistance of the cheese as it comes from the press to depression by a standard weight or by determining the stretching when a beam of the ripened cheese is subjected to a definite force. The latter determination is a good indication of the elasticity of the ripened cheese and is closely correlated with the grade.

The details of a method for making a cheese of the Bel Paese type have been completed and the cheese is now being made on a commercial basis. This is a semihard cheese with a mild flavor that ripens in a short time, and under proper storage remains in a marketable condition for several weeks. Carefully controlled low-temperature, high-humidity curing rooms are essential to the ripening of this cheese.



## BREEDING, FEEDING, AND MANAGEMENT INVESTIGATIONS

R. R. GRAVES, *in charge*

## THE EXPERIMENTAL BREEDING HERDS AT BELTSVILLE, MD.

## BREEDING EXPERIMENTS WITH HOLSTEIN-FRIESIAN CATTLE

The project to develop strains of Holstein-Friesian cattle that will be pure in their inheritance for a high level of production, by the continuous use of unrelated proved sires, is ready for the introduction of the sixth sire in the series. In the herd at present there are still 2 daughters of the first sire, Denton Colantha Sir Rag Apple; 17 daughters of the second sire, Varsity Derby Matador; 8 daughters of the third sire, Pride of the Bess Burkes; 5 daughters of the fourth sire, Count Piebe Hengerveld Ormsby; and 19 daughters of the fifth sire, Chief Piebe Ormsby Burke. The latter is still in service but the number of his daughters in the herd justifies the beginning of the next generation. Of these 51 outbred females, 31 have completed production records with a mature-equivalent average of 18,802 pounds of milk and 678 pounds of butterfat.

For comparing line breeding with outbreeding, the sire Sir Gerben Colantha Rube was used to produce the first line-bred generation; he was later replaced by a three-fourths brother, Sir Gerben Colantha Jolie. The former now has 17 line-bred daughters, 9 of which have finished production records with a mature equivalent average of 14,661 pounds of milk and 492 pounds of butterfat. The second line-bred generation is being sired by Pride Ormsby Gerben Colantha Ona, and he now has 8 line-bred daughters, 5 of which have just freshened.

The offspring of this sire (Pride Ormsby Gerben Colantha Ona) have been predominantly males, and in this herd 36 pregnancies have resulted in 26 males, 9 females, and 1 pair of mixed twins. He has been mated to daughters of four different sires with the same result in all cases. From daughters of Sir Gerben Colantha Rube he has 2 male and no female progeny; matings with daughters of Pride of the Bess Burkes resulted in 4 males and 2 females; when bred to daughters of Varsity Derby Matador he sired 17 males and 6 females; and his own daughters have had 3 males and 1 female from his service. Previously in a grade herd he had sired 3 females and about 15 males. This record is for his entire service period of over 5 years and is unusual for a sustained abnormal sex ratio. An effort will be made to determine, by close examination of his spermatozoa, whether or not they differ in any way from those of sires producing male and female offspring in about equal numbers.

Inbreeding trials to furnish additional genetic information on the various sires are carried on by mating daughters back to their own sires. There are 4 inbred daughters by Varsity Derby Matador, 8 inbred daughters by Sir Gerben Colantha Rube, 1 inbred daughter by Pride Ormsby Gerben Colantha Ona, and 5 inbred daughters by Double Gerben Colantha Hero (an inbred son of Varsity Derby Matador) out of the inbred daughters by Varsity Derby Matador.

Five mature Holstein cows completed records averaging 17,131 pounds of milk and 634 pounds of butterfat; and 12 Holsteins under mature age averaged 13,730 pounds of milk and 483 pounds of butterfat, at an average age of 2 years 9 months.

## BREEDING EXPERIMENTS WITH JERSEY CATTLE

The project to develop strains of Jersey cattle that will be pure in their inheritance for a high level of production is proceeding by the use of proved sires of three Jersey families. Comparisons of inbreeding with outbreeding and line breeding are being made by mating these proved sires to various groups of dams as well as to their own daughters.

The Owl-Interest group now consists of 2 outbred daughters and 1 inbred daughter of the first sire, The Moose O' Fernwood; 5 outbred and 5 line-bred daughters of the second sire, Oxford May's Interest Owl; and 4 outbred and 4 line-bred daughters of Marston's Interested Owl, the sire now in service. There are also 4 inbred daughters and 1 outbred daughter by sons of the first and second sires.

In the Sophie Tormentor group are 2 outbred daughters, 2 line-bred daughters, and 1 inbred daughter of the second sire, Sophie's Torono 23d; 8 outbred, 16 line-bred, and 3 inbred daughters of the third sire, Sophie's Phoenix, who is still in service; and 2 outbred daughters, 1 line-bred and 1 inbred daughter of sons of the above sires.

In the Raleigh group are 4 outbred daughters of the second sire, Tiddledy-wink's Raleigh; and 10 outbred, 2 line-bred, and 2 inbred daughters of the third sire, Raleigh's Dorothy's Senator. The latter is dead and has not yet been replaced.

The family-crossing project, planned to breed outbred descendants from 8 distinct families is now limited to the mating of 4-family individuals to produce offspring of the 8-family makeup. Twelve of the females are in the herd at Lewisburg, Tenn. At Beltsville there are 3 males and 9 females in the 4-family group, 1 female each in the 6- and 7-family groups, and 6 females in the 8-family group.

There are 97 females in the Jersey herd at Beltsville, and 41 of these have completed production records with a mature-equivalent average of 11,965 pounds of milk and 624 pounds of butterfat. During the past year 4 mature Jerseys finished production records averaging 11,913 pounds of milk and 696 pounds of butterfat; and 17 Jerseys under mature age averaged 8,613 pounds of milk and 464 pounds of butterfat, at an average age of 2 years 9 months.

#### PROVING BULLS

One hundred and four Beltsville-bred bulls are loaned to cooperators to prove their milk- and butterfat-transmitting ability. Information gathered from the cooperators' herds is furnishing an ever-increasing volume of data on the transmitting ability of the sons of the proved sires in service in the Beltsville herd.

The information gathered from cooperators has recently brought forth a case which illustrates the fallacy of placing too much dependence on the figures that are usually available when selecting a herd sire. The information assembled on 1 bull showed he had 8 daughters that averaged 12,735 pounds of milk and 449 pounds of butterfat, or 1,480 pounds of milk and 31 pounds of butterfat more than their dams. Six of the daughters excelled their dams in milk and five in butterfat production. On the basis of these records the sire looked good, but further information obtained by a visit to the herd where he had been used revealed that three other daughters had been used as nurse cows because the owner felt they were too poor to be kept in the herd and tested. Had they been given the same opportunity as their half sisters, there would be absolute proof of their producing ability. But this action on the part of the owner casts sufficient doubt on the performance of this bull to warrant his rejection as a herd sire, because at least one-fourth of his daughters are questionable producers. Many bulls are being judged today on information similar to that cited above. The wise breeder will use these assembled production records only as a guide in locating good bulls, and before selecting one as a herd sire he will take precautions to supplement the first information with additional facts gathered in the herd where the bull was in service.

#### RELATION OF THE CONFORMATION AND ANATOMY OF THE DAIRY COW TO HER MILK- AND BUTTERFAT-PRODUCING CAPACITY

##### ANTE-MORTEM AND POST-MORTEM STUDIES

In the study of the interrelations between external form, internal anatomy, and producing ability, the measurement of the external conformation and the slaughtering and detailed anatomical study of cows having records of production are the essential features. Owing to various unfavorable circumstances some of the cooperating State experiment stations have found it necessary to curtail their activities on this project during the year, and five (New York (Cornell and Geneva), Iowa, Missouri, and Washington) have discontinued the work altogether. On the other hand the Georgia (Griffin) Station has taken up the work, bringing the total number of cooperating stations to 15. Reports have been prepared on 65 cows having production records, making this one of the most active years since the project was commenced. Of this number, 45 reports were prepared at the Beltsville Station, 7 each at the Florida and South Carolina Stations, 2 at the North Dakota Station, and 1 each at the Kansas, North



Carolina, Oklahoma, and Utah Stations. The total number of reports now on file is 557. In addition, similar data were obtained during the year at the Beltsville Station on 5 bulls, 1 nonbreeding heifer, and 2 freemartins.

#### CONFORMATION AND GROWTH

In continuing the study of comparative growth and body proportions of animals at the Beltsville Station at different periods throughout their life, 296 sets of measurements and contours on 190 different females and 4 sets on 4 different bulls have been added bringing the total number of sets on file to 2,494 for females and 48 for bulls, representing a total of 636 different animals. Some of these growth and conformation data have been used by the Division of Dairy Herd-Improvement Investigations to prepare a table and tapeline with which a close estimate of the live weight of an animal of any age can be made by measuring its chest circumference (heart girth). The determination of volumes, contour areas, body proportions, and factors based on the interrelation of certain body measurements has been continued.

A photographic record of growth and conformation change has resulted in the addition of 275 photographs of females and 175 of bulls at definite ages up to 12 months—a total of 450 photographs involving 76 females and 47 bulls.

#### UDDER STUDIES

Continuation of the comparative study of the time and nature of early development, the changes during lactating life, the capacity, the gross anatomy, the histology, and the characteristics of the mammary tissue of cow udders, all in relation to demonstrated producing ability, has increased the amount of available data materially. During the year 344 observations on 91 animals were made to determine the degree and character of the mammary-gland development of calves and heifers ranging in age from birth to 18 months. The degree of mammary development present in the individual was compared with a standard for the same age based on similar examinations of a large number of animals, and evaluated accordingly. The cases of marked precocity as well as retardation in mammary development, which are found from time to time, should afford material for studying the significance of advanced or retarded development of the glandular tissue as regards potential producing ability. With the idea of determining the significance of variations in the development of the rudimentary mammary tissues in bulls, on the mammary development of their daughters, 149 examinations have been applied to 48 different bulls at varying ages during the year. Observations on the changes of condition in the udders of cows immediately preceding parturition and during lactation include 631 obtained according to regular schedule based on stage of gestation or lactation, and 44 additional ones made immediately preceding slaughter—a total of 675 involving 125 different cows, during the year.

Photographs of the udders of living animals include 86 sets (4 views to the set) of cows and 39 photographs of heifers at 18 months of age, making a total of 906 on file to date involving 440 animals. The time necessary for showing results in this and other similar long-time experiments is illustrated by the fact that, although this phase of the photographic work has been underway for about 8 years, the first complete series of udder photographs from 18 months through the ante-mortem set taken before slaughter are now becoming available with 15 on file, 13 of which were obtained during the year.

The plan of filling the secretory system of amputated udders with formalin and measuring the quantity held has been continued, with the addition of data showing the capacities of 33 lactating cows, 12 dry cows, 1 heifer, and 2 freemartins, making a total of 48 for the year and 263 since the beginning of the work. Average capacities for a few of the groups studied, expressed in weight of an equal volume of milk, are as follows: 34 lactating Holsteins, 66.82 pounds; 23 lactating grade Holsteins, 47.79 pounds; 43 lactating Jerseys, 48.58 pounds; 21 dry Holsteins, 42.75 pounds; 11 dry grade Holsteins, 37.22 pounds; 40 dry Jerseys, 24.28 pounds; and 10 nonbreeding heifers, 10.04 pounds. Capacity measurements for calves, totaling 44 in number, show a rather steady increase in udder capacity from 0.063 pound for the group under 3½ months of age to 7.23 pounds for the group ranging from 18½ to 24½ months of age. The largest cow udder (165.65 pounds empty weight) and the highest capacity (170.80 pounds) found to date were recorded during the year.

## QUANTITY OF MILK AND RATE OF RELEASE

The use of the four-unit milking machine, which permits a study of the rate of release and the quantity of milk obtained from individual quarters of the same udder, has been continued during the year with the addition of 37 records near the third month of lactation, 8 new series (representing different stages of lactation) started, 4 series completed through 9 months, and 10 terminated before 9 months. In all, 109 records of individual-quarter performance on 71 cows have been made. When available in sufficient numbers these records will afford an opportunity to study the significance of variations in the development of individual quarters noted by periodic examination in heifer calves, as well as the effect of injury, infection, and other udder disturbances through lactation, on the comparative subsequent performance of the quarters involved.

The study of the rate at which milk is drawn from individual cows has been continued. Sixty-five cow records, divided into groups according to production levels to determine the effect of level of production on the rate of milk flow, showed that the time required for milking increases with the amount produced, but not in proportion to the increased production. With a range in milk yield of 5.2 to 53.2 pounds per day, the time required per milking ranged from 5.9 to 8.63 minutes. The average rate of flow increased steadily and rapidly as the producing level increased, the rate in pounds per minute ranging from 0.65 to 4.90 for the first one-half minute, from 0.40 to 5.40 for the first 2½ minutes, from 0.47 to 3.78 for the second 2½ minutes, and from 0.18 to 0.86 for the second 5 minutes. The peak rate of flow also increased steadily from 1 pound per minute for the lowest to 6.70 pounds per minute for the highest production group. The proportion of milking time spent in massaging showed a marked tendency to decline as the producing level increased. Apparently the high-producing cows milked faster and more completely than the low-producing ones.

## HEALTH AND FERTILITY STUDIES IN THE BELTSVILLE HERDS

## BREEDING EFFICIENCY

Breeding efficiency is measured by the percentage of the animals bred that conceive. Forty-two grade Holsteins used in a close inbreeding experiment had a breeding efficiency of 83.3 percent; 79 registered Holsteins in the line-breeding-outbreeding experiment had an efficiency of 83.5 percent; 54 registered Jerseys in the inbreeding-outbreeding experiment had an efficiency of 85.2 percent.

More trouble is experienced in getting heifers to conceive for the first and second pregnancies than for later pregnancies. During the year, the average number of services required per pregnancy in the Holsteins was 3.38 for the first pregnancy, 2.5 for the second pregnancy, and only 1.57 for the third, fourth, fifth, or sixth pregnancy. For the registered Jerseys, the average number of services per pregnancy was 4.33 for the first pregnancy, 3.37 for the second, and 1.67 for the third, fourth, fifth, or sixth pregnancy.

In the abortion-negative herd, the 135 pregnancies terminated during the year resulted in 112 normal calves or 82.96 percent, 14 abortions or 10.37 percent, and 9 dead calves or 6.66 percent. This percentage of abortions in an abortion-negative herd seems very high, but is accounted for in part by the fact that the loss of a fetus at any stage of gestation is noted and recorded. Such losses would go unnoticed in many herds. Six of the fourteen abortions occurred less than 90 days after service, 4 occurred after pregnancy had run 123 to 162 days, and 4 after a pregnancy of more than 210 days' duration. Laboratory examination failed to reveal the cause of these abortions. No reactors to the abortion test have been found in the abortion-negative herd since two heifers reacted in June 1932.

This percentage of dead calves also seems unusually large for an abortion-negative herd. The cause of the death of 4 calves could not be determined; 2 were born dead as a result of injuries received during delivery; and 1 that was presented rear first died before it could be delivered. The list of dead calves includes one mummified fetus, and cases in which the cows reached the full term of gestation with enlarged uteri from which material was discharged with or without fetal debris.



Nine animals from the abortion-negative herd were slaughtered during the year because they were considered permanently sterile. Abnormal conditions of the genital organs in the abortion-negative breeding herd were found during the year as follows: Inflammation of uterus, 11 cases; inflammation of ovaries, 5 cases; inflammation of cervix, 1 case; ovarian cysts, 4 cases; persistent corpus lutea, 3 cases.

#### FERTILITY STUDIES

During the year, studies of the morphology and physiology of spermatozoa were made on 159 samples of semen collected from the herd sires, experimental bulls, and bulls loaned to cooperators.

In attempting to find a suitable media in which to keep spermatozoa viable for longer periods than they live in semen only, 145 different solutions were tried. Semen from at least two bulls was tried in each solution. In one sample spermatozoa remained active for 15 days and in many other samples from 6 to 11 days. In each case activity was vigorous. These results were with semen obtained by massage of the accessory genital organs of the bull. Attempts to maintain activity of spermatozoa collected from the vagina of the cow failed in every case.

Artificial breeding by collecting semen from a cow just bred and placing it in the vagina of another cow in oestrus was tried 21 times with no known conceptions, but the results from 5 of the 21 trials have not been determined. Similar semen was placed in the cervix in 9 cows; 3 of them conceived, and in 1 recent case the result has not yet been determined.

The method of obtaining the semen by massaging the accessory genital organs of the bull and placing the semen into the vagina of a cow in oestrus has been tried 3 times, with no conceptions. Similar semen has been placed in the cervix in 32 cows; 7 of them conceived, and in 3 recent cases the results have not yet been determined.

#### FEEDING AND MANAGEMENT INVESTIGATIONS AT BELTSVILLE

Work to determine the best methods for making grass silage, and its feeding value for dairy cows, was continued. The addition of 2 N hydrochloric and sulphuric acids, at the rate of 6 percent by weight, to chopped grass containing 28 percent dry matter, did not improve the palatability of the silage nor lessen the loss of dry matter. There was very little difference in the loss of dry matter in the silage made without acid and that made with acid. Exclusive of the unavoidable spoilage on top, the loss of dry matter was extremely small in all silos regardless of whether acid was added. The acid, however, may have been slightly helpful in preserving the carotene. In the silage to which acid was added, 87 percent of the carotene in the original grass was recovered; in that to which no acid was added, 80 percent was recovered.

Adding 10 percent by weight of 2 N hydrochloric and sulphuric acids to chopped alfalfa containing 40 percent dry matter had an adverse effect on the palatability of the silage. It seemed to have no effect one way or the other on the appearance and odor of the silage, or on the efficiency with which the dry matter was preserved. It was helpful, however, in preserving the carotene. Alfalfa made into hay for comparison with the silages was cured and stored with less loss of dry matter, although it did not contain as much carotene as the silages. Cows in a feeding experiment, consumed as much dry matter in the form of alfalfa silage made without acid as in the form of alfalfa hay and corn silage, but did not maintain body weight so well on the alfalfa silage.

A laboratory experiment in which acid was added to samples of chopped alfalfa having different moisture contents showed that acid prevented putrefaction in the high-moisture samples and that it helped to preserve the carotene in all the samples except the one with the highest moisture. Samples stored at a temperature of 38° C. lost less carotene than those stored at 20°. Alfalfa silage may be devoid of green color and still have a high carotene content; in hays, however, the green color and the carotene appear never to be dissociated.

In the fall of 1934, an investigation was conducted to determine the conditions necessary for the successful baling of corn stover. Stovers with different moisture contents were baled in both compact and loose bales. Some was shredded before being baled and some was baled without being shredded.

The higher the moisture content of the stover and the more compact the bales, the greater the temperature attained and the greater the formation of mold. The lowest content of moisture in any lot of stover was 26.7 percent but this did not keep perfectly even when baled loosely. Corn stover must be drier than this for perfect preservation in bales.

The cooperative experiment with the Bureau of Plant Industry to determine the merits of the Hohenheim system of pasture management is nearing completion. The results indicate that the returns from rotation grazing are 10 or 12 percent greater than from continuous grazing and that heavy applications of a complete fertilizer annually are not profitable. Experiments have been started to find out how much and what kinds of fertilizer will be profitable. So far, it appears that top dressing of established pastures with lime and superphosphate may be either ineffective or, if effective, only after several years, under the conditions prevailing at Beltsville.

It has been found that cows will graze enough grass to support a production of 1.5 pounds of butterfat a day at the Beltsville Station if the grass is tender and abundant but that in midsummer the grass usually becomes so short, so mature, or otherwise so unpalatable, that cows graze only enough to provide their requirements for maintenance. Apparently, a cow is able to graze in 1 day an amount equal to approximately 6 percent of the grass standing on 1 acre. The maximum consumption of dry matter a day is 30 to 35 pounds. This work shows why cows do so well on pasture early in the season and why they decline in production in midsummer. It emphasizes the necessity for supplementary pasture or supplementary feed at times when the permanent pastures are not at their best. Experiments are planned to determine the most practicable method of supplementing permanent pastures.

An investigation with 14 cows for several years showed that leaving a pound or so of milk in the udder at each milking did not cause udder troubles, abnormal milk, rapid drying off, or a lower percentage of butterfat in the milk, as is commonly supposed. When milked incompletely, the cows gave a little less milk than when milked completely. The difference was equal to about one-half of the milk left in the udders. This shows that cows should be milked out fairly completely, but that it is uneconomical to spend the time necessary to get the "last drop." With machine milking, a manipulation of the udder for an average of 20 seconds at the close of the milking is all that will ordinarily be required.

#### PHYSIOLOGICAL RESEARCH AT THE BELTSVILLE LABORATORY

During the past year considerable time has been devoted to the preparation of a motion-picture film which will be used in efforts to improve breeding practices throughout the United States. In this film the Bureau investigator has attempted to portray by use of time-lapse microcinematography the various physiological processes which take place in the uterine tract, oviducts, and ovaries during the fertilization and early developmental stages of the embryo. Living ova were obtained from rabbit oviducts and uterine tracts at known times after mating, and by special cultural technic these ova were kept alive outside the body from 1 to 5 days. These ova were developed in "tissue culture", and photographs were made at 20-second intervals to obtain a continuous record of the early development from the one-cell stage to the germ-disk stage—that is, from the earliest hour of development up to about the fifth or sixth day. The investigators are now making time-lapse photographs of the act of ovulation—that is, the bursting out from the ovary of the living ova. Also, for the first time cinematographs were made of living, viable, moving spermatozoa of several species, to show the motion of the spermatozoa in the female tract. In this connection cinematographs were made of the approach of spermatozoa to the living ova, portraying the act of fertilization in the mammalian ova.

These portions of the film grouped together, along with pictures of the chromosome arrangement of ova and spermatozoa, will tell the complete story of ovulation, fertilization, and development of the mammalian ova, and thus give the breeder of livestock a better understanding of the principles underlying Mendelian inheritance.

An interesting fact was observed in connection with the photographic studies of the developmental history of rabbit ova. It was noted that, by control of the temperature of the media in which the ova were cultured, one could slow down the development of the ova materially. It was found possible to keep the ovum in the one-cell stage up to 24 hours and then return it to normal



body temperature with normal development ensuing. This offers an experimental tool to get at the problem of twinning, monster formation, and other terratological problems.

During the past year investigators have been preparing from human pregnancy urine the anterior pituitarylike principle. This principle has been used on senile and sterile bulls in the hope that the breeding condition of these animals could be improved. The data to date are not enough to draw definite conclusions concerning the effectiveness of this type of treatment, though in some cases favorable results appear to have been obtained.

Further studies on uterine motility of the cow uterus have confirmed earlier results. The investigators have attempted to determine the activity of the corpus luteum of the cow by following uterine motility each day after oestrus. It has been noted that the uterus after ovulation is relatively refractive to pituitrin up to the fourteenth to sixteenth day following ovulation. After this period the uterus, with the development of the new follicle shows again some increase in response to pituitary injections, this increase being greatest on the day before and the day after the next oestrus. These data will provide information concerning the relative life of the corpus luteum and also will aid in the determination of the exact time of ovulation in these species.

The experiments on preservation of spermatozoa for artificial insemination are being continued. Information has been gained concerning the chemical constituents of the seminal fluid which it is hoped will be an aid in preparing media for preservation of the spermatozoa.

#### WORK AT THE FIELD EXPERIMENT STATIONS

##### GENERAL

On June 30, 1935, the seven field-station herds had a total of 436 cattle; 388 were females and 48 were bulls. In addition, there were approximately 125 bulls loaned to cooperators in the proved-sire breeding project.

The sharp curtailment program adopted at these field stations in 1934 to meet reduced-budget allotments and feed shortage was continued in 1935 with the result that 69 females were slaughtered, sold for slaughter, or loaned to other Government institutions. The herds in general are still too large to come within the reduced budgets; but in some cases they are so reduced in size that experimental work is suffering. Animals that would ordinarily be used for feeding experiments have been disposed of because of shortage of funds for feed and labor. This leaves only the younger animals and they cannot be used for experimental feeding tests because they are on official test.

In connection with the breeding experiments, 64 cows and first-calf heifers completed official production records during the year, averaging 11,051 pounds of milk and 434 pounds of butterfat, at an average age of 2 years 10 months. The cows in the station herds, with the exception of those on official test, are fed largely on roughage alone.

##### MANDAN, N. DAK., STATION

Because of drought, very little feed was raised on the farm in 1934, the reserve supply was exhausted, and it was necessary to purchase nearly all the year's supply. This year the prospects are good for high yields in most crops. Progress in proving out bulls loaned from the station was checked because of unusually poor feeding conditions in local herds. Pasture experiments and experiments to show the comparative costs of producing feed nutrients in different crops have been almost at a standstill. Because of feed shortage, the entire herd except the cows on official test was placed on a limited-grain plane of feeding, consisting of prairie grass, grain, Russian-thistle hays, and a limited amount of alfalfa hay. Grain was fed at the rate of 1 pound for each 6 pounds of milk produced. The pasture was very short and dry. Eight cows completing records under this system of feeding averaged 10,730 pounds of milk and 379 pounds of butterfat, at 4 years 9 months of age. The average lactation period was approximately 300 days.

##### HUNTLEY, MONT., STATION

Several additional cows completed yearly production records on early-cut grass, fed as hay or silage. Three cows fed exclusively on early-cut grass hay

for entire lactation periods averaged 11,060 pounds of milk and 404 pounds of butterfat. Two cows fed immature-grass silage averaged 8,559 pounds of milk and 327 pounds of butterfat. Seven cows fed alfalfa hay, corn silage, and pasture averaged 10,883 pounds of milk and 362 pounds of butterfat. These 12 cows, fed exclusively on roughage, averaged 10,540 pounds of milk and 366 pounds of butterfat.

Data were collected to show the cost of producing total digestible nutrients in various irrigated crops grown for dairy feed on the Huntley Station farm, as follows:

<i>Crop, and yield per acre</i>	<i>Cost per 100 pounds</i>
Wheat (32.8 bushels)-----	\$1.35
Oats (77.7 bushels)-----	.98
Barley (47.9 bushels)-----	1.13
Corn silage (10 tons)-----	1.19
Grass silage (5.7 tons)-----	1.50
Alfalfa hay (4.4 tons)-----	.54
Grass hay (2.2 tons)-----	.69
Pasture (305 cow-days)-----	.33

The lower cost of producing total digestible nutrients in hays and pasture at the Huntley Station is in keeping with costs compiled by the Bureau from other localities. The cost of nutrients in silage, particularly grass silage, appears to be higher than in most other crops. The cost of the grass silage was greatly increased because of the shortage of water and the difficulty of properly irrigating this particular field, which resulted in a low yield for the third cutting.

To date a total of 49 bulls have been proved in cooperators' herds near Huntley. Table 1 shows the average production of the daughters of each bull. These 49 bulls have sired 579 daughters that have records that can be compared with their dams' records. The average production of the 579 daughters was 11,227 pounds of milk and 404 pounds of butterfat, calculated to maturity. The average production of their dams was 9,775 pounds of milk containing 347 pounds of butterfat. The average increase in production of the daughters over their dams was 1,452 pounds of milk and 57 pounds of butterfat. Forty-four of the 49 sires raised average milk production, 35 raised the average percentage of butterfat, and 46 raised average butterfat production. Many of the records were made on farms where little, if any, grain was fed.

TABLE 1.—Average production of the daughters of 49 sires bred by the Bureau of Dairy Industry and used in farmers' herds near Huntley, Mont., compared with the production of the dams of the daughters

[All records calculated to a mature basis]

15 SIRES, SONS OF MAPLESIDE KING PAUL

Sire no.	Daughter and dam comparisons	Daughters				Dams				Increase (+) or decrease (−) of daughters over dams		
		Milk		Butterfat		Milk		Butterfat		Milk	Butterfat	
	Number	Pounds	Percent	Pounds	Pounds	Percent	Pounds	Pounds	Percent	Pounds		
H-107-----	23	11,380	3.82	434	9,358	3.73	349	+2,022	+0.09	+85		
H-109-----	13	10,319	3.66	378	7,025	3.78	266	+3,294	−.12	+112		
H-111-----	27	9,813	3.48	342	9,378	3.36	315	+435	+ .12	+27		
H-112-----	28	12,189	3.63	444	9,091	3.69	336	+3,098	−.06	+108		
H-113-----	6	9,618	3.51	338	9,669	3.26	315	−51	+ .25	+23		
H-114-----	10	8,729	3.84	336	7,825	3.61	283	+904	+ .23	+53		
H-115-----	18	11,509	3.52	406	9,320	3.53	330	+2,189	−.01	+76		
H-116-----	10	12,203	3.56	435	9,798	3.66	358	+2,405	−.10	+77		
H-117-----	30	10,330	3.68	380	10,749	3.58	385	−419	+ .10	−5		
H-118-----	21	11,597	3.59	418	10,290	3.57	367	+1,307	+ .02	+51		
H-120-----	11	11,610	3.48	405	8,437	3.59	304	+3,173	−.11	+101		
H-121-----	7	13,034	3.57	466	11,937	3.62	433	+1,097	−.05	+33		
H-123-----	14	9,742	3.47	339	7,458	3.44	257	+2,284	+ .03	+82		
H-126-----	33	13,625	3.61	490	11,712	3.58	419	+1,913	+ .03	+71		
H-127-----	9	9,624	3.53	340	7,400	3.70	274	+2,224	−.17	+66		
Total-----	260	2,921,334	-----	105,479	2,488,751	-----	89,161	-----	-----	-----	-----	-----
Average-----		11,236	3.61	406	9,572	3.58	343	+1,664	+ .03	+63		



TABLE 1.—Average production of the daughters of 49 sires bred by the Bureau of Dairy Industry and used in farmers' herds near Huntley, Mont., compared with the production of the dams of the daughters—Continued

[All records calculated to a mature basis]

## 18 SIRES, SONS OF FRIEND ONA HARTOG KORNDYKE

Sire no.	Daughter and dam comparisons	Daughters			Dams			Increase (+) or decrease (−) of daughters over dams		
		Milk		Butterfat	Milk		Butterfat	Milk		Butterfat
		Number	Pounds	Percent	Pounds	Pounds	Percent	Pounds	Percent	Pounds
H-130.....	8	10,081	3.58	354	8,214	3.76	309	+1,867	−0.18	+45
H-131.....	8	9,439	3.91	369	7,909	3.67	291	+1,530	+ .24	+78
H-132.....	14	11,654	3.68	428	9,920	3.65	362	+1,734	+ .03	+66
H-135.....	13	11,064	3.55	393	9,853	3.51	346	+1,211	+ .04	+47
H-136.....	3	9,678	3.68	357	8,415	3.84	324	+1,263	− .16	+33
H-137.....	3	11,084	3.84	426	8,245	4.51	373	+2,839	− .67	+53
H-139.....	9	11,168	3.33	372	11,269	3.44	388	−101	− .11	−16
H-141.....	17	11,759	3.56	418	10,711	3.54	379	+1,048	+ .02	+39
H-145.....	7	11,434	3.91	447	9,490	3.61	344	+1,944	+ .31	+103
H-147.....	7	9,134	3.64	332	8,756	3.47	298	+378	+ .17	+34
H-148.....	4	13,165	3.45	455	10,150	3.28	334	+3,015	+ .17	+121
H-151.....	17	10,906	3.48	380	9,583	3.46	332	+1,323	+ .02	+48
H-152.....	3	10,664	4.05	432	8,001	4.15	332	+2,663	− .10	+100
H-154.....	11	14,437	3.55	512	10,893	3.48	379	+3,544	+ .07	+133
H-157.....	4	13,235	3.47	459	12,233	3.33	408	+1,002	+ .14	+51
H-158.....	5	15,512	3.27	508	10,107	3.37	341	+5,405	− .10	+167
H-161.....	15	12,581	3.32	417	11,373	3.11	354	+1,208	+ .21	+63
H-167.....	12	11,393	3.70	421	11,292	3.68	412	+101	+ .02	+9
Total.....	160	1,854,617	-----	66,032	1,610,066	-----	56,622	-----	-----	-----
Average.....	-----	11,591	3.56	413	10,063	3.52	354	+1,528	+ .04	+59

## 7 SIRES, SONS OF COLANTHA PONTIAC HERO

A-107.....	17	9,959	3.69	367	8,628	3.68	318	+1,331	+0.01	+49
A-108.....	8	9,003	3.46	307	9,068	3.28	298	−65	+ .18	+9
A-109.....	11	10,229	3.45	354	9,230	3.44	318	+999	+ .01	+36
A-119.....	6	10,457	3.72	390	7,611	3.45	263	+2,846	+ .27	+127
A-120.....	8	10,030	3.59	361	8,596	3.42	294	+1,434	+ .17	+67
A-121.....	14	10,452	3.56	373	9,915	3.55	352	+537	+ .01	+21
A-126.....	4	12,082	3.63	438	10,999	3.52	387	+1,083	+ .11	+51
Total.....	68	691,484	-----	24,791	617,990	-----	21,694	-----	-----	-----
Average.....	-----	10,169	3.59	365	9,088	3.51	319	+1,081	+ .08	+46

## 3 SIRES, SONS OF PRIDE OF THE BESS BURKES

H-169.....	3	18,027	3.52	657	13,828	3.09	428	+4,197	+0.43	+229
H-170.....	8	9,790	3.89	382	10,579	3.69	390	−789	+ .20	−8
H-175.....	6	16,893	3.93	664	16,830	3.72	625	+63	+ .21	+39
Total.....	17	233,753	-----	9,011	227,096	-----	8,154	-----	-----	-----
Average.....	-----	13,750	3.86	530	13,359	3.59	480	+391	+ .27	+50

## 6 SIRES, SONS OF MISCELLANEOUS SIRES

H-104 <sup>1</sup> .....	8	11,453	3.55	407	10,130	3.54	359	+1,323	+0.01	+48
H-105.....	13	10,266	3.67	377	10,030	3.64	365	+236	+ .03	+12
H-129.....	13	11,434	3.56	409	10,110	3.52	356	+1,324	+ .04	+53
H-257.....	21	10,042	3.48	350	8,379	3.47	291	+1,663	+ .01	+59
A-104.....	4	10,611	3.59	380	8,846	3.85	341	+1,765	− .26	+39
A-105 <sup>2</sup> .....	15	11,489	3.73	429	10,775	3.58	386	+714	+ .15	+43
Total.....	74	799,385	-----	28,779	715,828	-----	25,510	-----	-----	-----
Average.....	-----	10,803	3.60	389	9,673	3.57	345	+1,130	+ .03	+44
Grand total.....	579	6,500,573	-----	234,092	5,659,731	-----	201,141	-----	-----	-----
Average.....	-----	11,227	3.60	404	9,775	3.55	347	+1,452	+ .05	+57

<sup>1</sup> Mapleside King Paul (see opposite page).<sup>2</sup> Friend Ona Hartog Korndyke (see above).

## WOODWARD, OKLA., STATION

Because of the sharp reduction in size of the herd to meet feed shortage and reduced allotment, no experiments other than the continuation of the breeding project and the roughage-feeding experiments were attempted. For the most part it has been necessary to dispose of cows as soon as they finish their first normal production records. As a result, the herd is now composed largely of first-calf heifers and young cows. Three cows, fed only on alfalfa hay and cane silage, averaged 11,752 pounds of milk and 377 pounds of butterfat. Two of the cows were only 3 years of age. This is considerably higher production than was obtained at this station on straight alfalfa-hay feeding, whereby 7 cows completed 11 records that averaged 10,039 pounds of milk and 329 pounds of butterfat.

## JEANERETTE, LA., STATION

The nasal disease prevalent in the herd has shown no abatement. This disease, together with anaplasmosis, has lowered production to such an extent that register-of-merit testing has been discontinued until such time as improved health conditions warrant starting again. In cooperation with the Bureau of Animal Industry experimental treatments, using several forms of iodine, have been started with the hope of checking or curing the nasal disease. Five cows died of anaplasmosis during the year. An experiment is also in progress whereby young bulls, starting at 6 months of age, are fed entirely on machine-dried roughage.

## PONTIAC, S. C. (SAND-HILL), STATION

Dry weather sharply reduced the carrying capacity of the annual grazing-crop experiment and also killed out several plots of alfalfa used in conjunction with the grazing plots.

Uplands General, the second proved sire used in the herd, died at the age of 13 years, and to date has not been replaced. His first four daughters to complete records in the station herd averaged 626 pounds of butterfat, calculated to maturity, as compared to an average of 586 pounds for their dams. Twelve additional daughters of this bull are now in the herd and several cows are in calf to him.

## HANNIBAL, MO., STATION (THE HATCH FARM)

Dry weather has again delayed the experiment to determine the effect of various fertilizer treatments on the yield of pasture herbage. It is expected that the division of the large bluegrass pasture, much of which is on rather rough land, will make it possible to utilize the grass better; and also to do experimental work in handling the surplus growth in the spring months, in the form of immature-grass silage or hay.

## LEWISBURG, TENN., STATION

Goldie's Torono Lad, the first proved sire sent to the Lewisburg station, died at the age of 15 years. He sired 19 daughters in the herd. Prince Tiddledywick Torono, a proved Jersey bull, bred at the Beltsville Station and proved at the South Carolina Agricultural Experiment Station, was sent to Lewisburg to replace Goldie's Torono Lad.

The feeding experiment at this station whereby Jersey heifers at 1 year of age are placed on a ration of roughage alone (machine-dried hay during winter and pasture during the summer) has progressed sufficiently to warrant conclusions that Jersey heifers will make satisfactory growth (as measured by body weight) when given unlimited quantities of a good quality of machine-dried legume hay during the winter and abundant pasture during the summer. Preliminary data appear to indicate that 6 months of age is too early to place heifers on an exclusive roughage ration, if normal growth is to be maintained.

The experiment to determine the comparative color of butter from two groups of cows receiving machine-dried and field-cured hay, respectively, will be continued. Experiments to determine the effect on total consumption of hay when more than one variety is fed and when the hay is fed in dry form and when moistened with water, are being continued.



## COOPERATIVE WORK AT UTAH AND WESTERN WASHINGTON EXPERIMENT STATIONS

At the Utah Agricultural Experiment Station a feeding experiment is nearing completion in which a group of 12 cows will have completed lactations on the following four rations: (1) A full-grain ration with alfalfa hay, corn silage, and irrigated pasture; (2) alfalfa hay and pasture; (3) alfalfa hay, corn silage, and pasture; and (4) barley as the sole grain ration, with alfalfa hay and pasture.

The third consecutive proved sire is in use in the breeding project.

At the Western Washington Experiment Station a cooperative project has been completed, and the results published, on the effect of temperature of artificial drying on the digestibility and availability of nutrients in pasture herbage.

The milking herd has been divided into three groups for feeding the following experimental rations: (1) Field-cured grass hay cut at a fairly early stage of maturity; (2) silage made from pasture grass, and also from oats and peas, and from oats and vetch; and (3) hay and silage. All groups are on pasture during the pasture season but no grain is fed at any time. The level of production, the economy of production, the color of the butterfat, and the vitamin A content of the butterfat are being studied.

Experiments are being conducted to determine the comparative economy of curing silage in stacks and in the upright silo, and the relative nutritive values of the silage.

## DIVISION OF MARKET-MILK INVESTIGATIONS

ERNEST KELLY, *in charge*

## DAIRY SANITATION

The Division of Market-Milk Investigations cooperated in Bureau studies of heavy cottonseed meal feeding in relation to udder troubles in dairy cows. The liberal feeding of the experimental cows on a high-protein ration composed of cottonseed meal and alfalfa hay had little, if any, influence on the normality of the milk. Neither did such a ration aggravate udder conditions as determined by physical examination of the udders and by the laboratory examination of the milk; nor did the high-protein ration force animals more or less subject to chronic attacks of mastitis into clinical cases.

The Division also cooperated in a Bureau study of the effects of complete and incomplete milking. Some of the conclusions were:

Incomplete milking had no apparent effect on the percentage of fat in the milk; incomplete milking did not increase either the number of cells, the total bacteria, or *Streptococcus mastitidis*, when the averages of all lactations were studied; there was a tendency for milk to show a gradual increase in chlorine content from the beginning to the end of the lactation; incomplete milking did not increase the prevalence of clinical cases of mastitis, or of other udder troubles.

Work was continued on the brom-cresol purple method of detecting abnormal milk. R. P. Hotis, before his death, had practically completed work on a new test he had developed. This is believed to be the best of all tests for the detection of mastitis milk and is already being used in field work to some extent.

## MILK-PLANT MANAGEMENT INVESTIGATIONS

Further work has been done in tabulating and presenting the data previously collected on country receiving stations. Six graphs show the relation of volume of milk received to costs of operation per unit and to investments in buildings and equipment. These indicate clearly that many plants are operating with a volume too low to be economical. Thirty-nine photographs illustrating various types of plants and various arrangements have been filed.

At the request of a dairy plant that was having trouble with cream-plug formation on bottled milk, a member of this Division was assigned to determine the effect of different plant operations and milk treatment on the formation of plug. Samples were taken daily at various points in the plant and under varying conditions. The following principles apply to the results of this study:

The "cream plug" consists of masses or clusters of fat not in normal emulsion. Any factor or process that causes clumping or coalescing of the fat globules will increase the tendency to form plug. The degree of clumping depends on the size of the globules, temperature, and amount of agitation. It is generally agreed that there is a tendency for the globules to coalesce or clump at from 45° to about 90° F., and that above 140° little or no clumping occurs. As it is necessary for the globules to come into contact with one another before they can coalesce, agitation at temperatures favorable to coalescence increases the degree of clumping. The larger fat globules clump more readily and also rise faster than the smaller ones. It is also true that the fat in milk from grass-fed cows tends to be softer than that in milk from cows on dry feed, and the globules will coalesce more readily. Larger fat globules tend to be present at the beginning of the lactation period than near the end. Also, they are larger in milk from Jerseys and Guernseys than from Holsteins or Ayrshires.

Agitation of milk by various machines in milk plants, such as pumps, etc., tends to increase the number of large fat globules. Agitation at favorable temperatures results in clumping of the fat globules, and if continued long enough will cause butter to form. Beating air into the milk or cream increases the rate of clumping. The temperatures most favorable for churning cream are from 45° to 60° F., and lower temperatures are usually used in summer than in winter. One authority gives 48° to 54° as the best churning temperatures for summer. At temperatures above 75° and below the melting point of fat (approximately 90°) little butter is obtained. Above the melting point of fat no amount of churning will produce butter but it will cause a subdivision of the large globules. Below 40° the globules do not adhere to one another and therefore agitation at such temperatures merely distorts the shape of the globules. The large globules rise much faster than the small ones and plug formation is more likely to occur when there are large globules. Plug formation also occurs more readily if the bottled milk is stored at higher temperatures, and this likewise accounts for the greater plug formation on milk that has been out on the route wagons uniced on warm days.

During the course of experiments at the plant a number of suggested changes in the equipment and methods of operation seemed to assist in decreasing the amount of cream-plug formation. The following recommendations are based on the results of the tests made:

(1) All milk should be cooled immediately after milking and stored at 50° F. or below; (2) morning's milk should not be mixed with night's milk at the farm as is sometimes done in filling cans that could not be filled at the previous milking because of foam; (3) milk should be shipped in full cans only, kept cold during transportation from the farm, and agitation avoided; (4) cream should not be added to raw milk at the plant as it may possibly aggravate the trouble; (5) milk should not be allowed to freeze on the cooler, as freezing causes the fat to gather in masses and plug formation results; (6) milk should be stored in the plant at not over 45°; (7) milk should not be allowed to warm up on the routes, as the trouble will be increased considerably; and (8) milk should not be agitated at temperatures between 50° and 95°. This of course is difficult to avoid, but the following procedure will help: (1) Do not let the milk pumps pump air at any time and shut them down if milk is not coming to them; (2) lengthen the pipes leading to the tank so they deliver the milk at the bottom of the tank with no splashing, and replace the right-angle bends with round bends in the pipes wherever possible; (3) avoid excessive agitation of the milk in the storage tank—the pumping and agitation that takes place in handling vitamin D milk no doubt tends to increase the trouble; (4) see that the clarifier is of large enough capacity to be operated without unduly agitating the milk and to deliver the milk to the preheater without foam; (5) the removal of the "dead end" from the pan under the preheater, where foam and butter collect, no doubt will help to eliminate one of the causes of the trouble; (6) as the milk is agitated somewhat between the preheater and pasteurizer, it is desirable that it be preheated to a temperature above the melting point of fat (90°) so that this agitation will not "churn" the milk and cause clumping of fat globules; (7) rinse out all milk-storage tanks before refilling with milk a second time; (8) see that clarifiers and pumps are supplied with milk at all times when in operation, and that the pump at the receiving tanks is of a type that does not unduly agitate the milk; and (9) cool the milk quickly and with as little agitation as possible, especially between 95° and 45°. The removal of



the distributing pan on the cooler eliminates agitation at a "critical" temperature.

It is believed that the greatest source of trouble is the agitation of the milk before it is pasteurized, as at those temperatures agitation tends to cause clumping of the fat globules. The suggested precautions will reduce some of the agitation; the presence of foam in large quantities indicates that the milk has been agitated too much. It is probable that if the milk were preheated to a point above the melting point of fat before it is pumped or sent through the clarifier there would be no cream plug. However, this procedure might result in a poorer cream line on the milk. Cream plug is of considerable economic importance to the industry, for if it is not prevented it results in losses to the distributor and tends to decrease consumption of market milk.

#### MILK-QUALITY IMPROVEMENT INVESTIGATIONS

##### EFFECTIVENESS OF CLARIFIER IN REMOVING LEUCOCYTES FROM MILK

This project is a continuation from last year. The following results have been obtained to date. The leucocyte count of 106 samples of milk was reduced from an average count of 996,800 per cubic centimeter before clarification to an average count of 275,200 after clarification at 20° C. at the rated speed of the clarifier. This was a decrease in leucocyte count of approximately 72.3 percent. Clarifying at the half-rated speed of the clarifier reduced the average leucocyte count of 61 samples from an average of 1,086,100 to an average of 583,100 per cubic centimeter. This was a reduction of only approximately 46.3 percent.

This work has all been done with the same clarifier and before definite conclusions can be drawn it is desirable that the work be extended to other clarifiers. These results indicate, however, that clarification of milk at 20° C. at the rated speed of the clarifier removes approximately 72 percent of the leucocytes and that the speed of the clarifier affects its effectiveness to a considerable extent.

To determine what happens to the leucocytes in milk when it is separated centrifugally, the leucocyte count was made on several samples of whole milk and then on the skim milk and cream. The whole milk had an average count of 541,566 leucocytes per cubic centimeter. The number of leucocytes in the skim milk was approximately 40 percent less than in the whole milk, and in the cream the number was approximately 61 percent less.

##### CURD TENSION

Considerable work has been done on the curd tension of milk during the past year. While this work has not progressed to such an extent that conclusions can be drawn, it has indicated that the methods commonly used for determining curd tension are not sufficiently accurate for scientific investigations and curd tension as usually determined does not indicate both, if either, the suitability of milk for cheesemaking and the digestibility of milk.

The results obtained by the method commonly used for determining curd tension vary greatly. Check samples of the same milk may vary over 30 g in curd tension. Curd-tension readings of milk also vary with the coagulant used. Hydrochloric acid and pepsin, calcium chloride and pepsin, and rennet give a different curd-tension reading for the same milk. It is therefore believed that the coagulant should simulate the coagulant with which the milk comes in contact in the process of manufacture or digestion.

Attempts have been made to make a coagulant in the form of artificial gastric juice from hog-stomach lining. Difficulty has been encountered in obtaining an artificial gastric juice having a pH and titratable acidity corresponding to gastric juice. The method of making has been corrected and as soon as stomach linings are available artificial gastric juice will again be used as a coagulant.

If methods of determining curd tension are to have any appreciable value from a market-milk standpoint, the results should be capable of being correlated with digestibility. Much time has therefore been spent in attempting to obtain a method for measuring digestibility. A modification of a test to determine the strength of pepsin was tried. The fat in milk interfered with the accuracy of this test. Trichloroacetic acid was then used to remove the fat after digestion, but without success as it also precipitated the partly digested protein. At present alcoholic titration of the carboxyl group is being tried and indications are

that it may prove to be satisfactory. It is hoped that an accurate method for measuring both the curd tension and digestibility of milk can be developed in the near future.

#### CHOCOLATE-FLAVORED MILK

Phases of this work were practically completed last year; but to obtain the most satisfactory sirup formula, a recheck was made on the preference between three amounts of sugar and several amounts of salt. The sirup formula finally decided upon was: 1 part, by weight, of cocoa, 5 parts of sugar, 4 parts of skim milk (or water), and 0.2 percent of salt. This sirup is to be added to whole milk at the rate of 1 part by weight of sirup to 10 parts of milk.

Some samples of commercial sirup and one sample of a material to prevent sedimentation were tried out. The material to prevent sedimentation was somewhat difficult to mix but accomplished the purpose satisfactorily.

#### DEVONSHIRE CLOTTED CREAM

Further trials in making Devonshire cream have been rather unsatisfactory. Some improvement in body and flavor was obtained by adding starter, but the resultant product was not considered to be exceptionally desirable. Some improvement was also obtained by increasing the time at which the product was held at the highest temperature; but to the extent of the knowledge of the Bureau staff of the real flavor and texture, the product did not meet requirements. By reducing the fat content of the cream used to about 30 or 35 percent in the factory method of manufacture, both the body and flavor of the product were somewhat improved. The improvement in flavor was to some extent due to the formation of less butter oil than with the heavy cream. The improvement in body was ascribed to the increase of solids not fat. It is generally conceded that any clotted cream this Division has been able to make so far does not warrant commercial development.

#### HERD-IMPROVEMENT INVESTIGATIONS

J. C. McDOWELL, *in charge*

For the first time in 5 years the dairy herd-improvement association work has shown an increase in number of associations and in number of cows on test. On January 1, 1935, there were 809 associations, with 364,218 cows on test. This was an increase of 16, or 2 percent, in the number of associations and 38,381, or 10.5 percent, in the number of cows on test, as compared to a year earlier. Dairy specialists in every section of the country report increased interest in association work. While no detailed report has been compiled since January, partial reports indicate that the growth still continues and at a more rapid rate. The greatest gain during the fiscal year, however, has been in the quality of the records received from the field, and in the added interest in bull-proving work.

It is generally considered that it will pay the owner of a herd of 11 cows or more to join a dairy herd-improvement association. According to Government figures there are 432,060 dairy herds of 11 cows or more in the United States. If the owners of these herds were to organize herd-improvement associations, each consisting of 26 members, there would be 16,618 associations instead of 809, or more than 20 times the present number.

#### PRODUCTION PER COW ADVANCING

The testing of cows for economical production of milk and butterfat began in 1906. The average butterfat production of the cows on test that year was 215 pounds. By 1920 the average butterfat production of the cows on test was 247 pounds, by 1929 it was 298 pounds, and by 1934 it was 322 pounds. The cows on test are now producing 107 pounds more butterfat than those on test in 1906, and more than twice as much as the average milk cow of this country.

Other studies have shown that profits per cow advance at a rapid rate as production per cow increases. One of the recent tabulations of the records of dairy cows on test shows that cows whose yearly production was 158 pounds (the United States average in 1934) produced butterfat at a feed cost of 28 cents per pound and that cows with a yearly production of 322 pounds (Dairy Herd-Improvement Association average) produced butterfat at a feed cost of



19 cents per pound. Thus, the average cow on test produced butterfat at a feed cost of approximately 9 cents less than the average cow in the United States. Continuous testing, selection, and better feeding and breeding are directly responsible for this increased efficiency of cows in dairy herd-improvement associations.

Of the cows on test during the last calendar year 56,000 were registered and 70,000 were designated as grades of the leading dairy breeds. The average production of the registered cows was 8,462 pounds of milk containing 335 pounds of butterfat. The average production of the grade cows was 7,662 pounds of milk containing 310 pounds of butterfat. The registered cows excelled the grade cows in milk production by 10 percent and in butterfat production by 8 percent.

Production per cow as shown by dairy herd-improvement association records does not always give the whole story of profit or loss on the dairy farm. A dairyman may have a well-bred, high-producing herd yet fail to make a profit from his farm. With the counsel of the Division of Farm Management and Costs, Bureau of Agricultural Economics, plans are now being outlined for studying the problem of obtaining more complete data on both the herd and the farm.

#### PROVED BULLS

During the last fiscal year 542 bulls were proved in dairy herd-improvement associations. The daughters of these bulls averaged 420 pounds of butterfat and the dams of the daughters 407 pounds. This was an increase of 13 pounds, or 3.2 percent, by the daughters over their dams. The daughters of 33 sons of proved sires had an average yearly butterfat production of 420 pounds, compared to an average of 399 for their dams. The daughters excelled the dams by 21 pounds, or 5.3 percent. During the fiscal year 31 bull-association bulls were proved. On an average the daughters of these bulls produced 431 pounds of butterfat per cow and the dams of the daughters averaged 413 pounds. The daughters excelled the dams by 18 pounds, or 4.4 percent.

Proved-sire work in dairy herd-improvement associations has developed at a rapid rate. Many States have set up State proved-sire programs with the result that the work is not conducted uniformly throughout the country. Plans were made during the year to devise a uniform program which would be adopted by all States. The problem was discussed at the 1935 annual meeting of the American Dairy Science Association, and a national program was outlined. Briefly, it included the following features: The type of lactation record to be used in making dam-and-daughter comparisons for proving sires is to consist of the first 305 days' production of a cow, raised to maturity, and reduced to a two-times-a-day milking basis. When more than one record is available for a dam or daughter the average of all records is to be used.

A successful proved-sire program is dependent on the accurate identification of all dams and daughters on test. A system is being perfected which, by the use of ear tags, is designed to insure accurate identification of all animals in dairy herd-improvement associations.

#### DAIRY MANUFACTURING INVESTIGATIONS AND INTRODUCTION

R. W. BELL, *in charge*

The Division of Dairy Manufacturing Investigations and Introduction assisted in preparing a model cream-grading bill and participated in a meeting of State dairy officials of 13 States in Chicago, on November 21 and 22, where the model bill was modified and adopted for recommendation to the respective State legislatures. The Division also assisted in preparing the proposed United States grades of cream for buttermaking. These were the grades suggested by the Agricultural Adjustment Administration in its proposal to the Western States to adopt uniform cream grades and butter grades and grade marking of the consumer package. These grades are still merely tentative.

Division specialists assisted the Agricultural Adjustment Administration and the Bureau of Agricultural Economics in grading and inspecting the evaporated milk purchased by the Government for relief purposes, and in other ways in an advisory capacity. The Tennessee Valley Authority requested assistance on projects involving the promotion of agricultural development and cooperative endeavor within its territory. Recommendations on how to proceed to obtain the best results were made in each case.

Participation in dairy-products judging contests and dairy-manufacturing short courses continued. Requests for help in the manufacture of casein, cottage cheese, evaporated milk, Roquefort cheese, and other milk products were complied with. In many instances the problems received the personal attention of the specialist, particularly problems in the manufacture of Swiss cheese in plants whose location or other conditions made it advisable to furnish specialists from the Washington office. The manufacture of Swiss cheese is a highly technical process. Consequently, in a plant making a large number of wheels daily, it would be highly desirable to employ permanently a man trained in the fundamentals of Swiss cheese bacteriology. A properly trained technical man may increase the value of the Swiss cheese made at a large factory to such an extent that he will be the most valuable employee in the organization.

#### CREAMERY INTRODUCTION

The creamery introduction project in Tennessee was continued in cooperation with the extension service of the university. The Food and Drug Administration's campaign against low-grade cream and butter furnished additional incentive for quality-improvement work in the State. Some creameries that, in the past, had been lukewarm toward the Federal-State project found it helpful to become actively cooperative. A creamery and cream station "clean-up" campaign was carried on with the full cooperation of the State dairy commissioner and the creamery operators. The filter test for extraneous material in cream was demonstrated, and an acceptable type of farm milk strainer with filter pads was exhibited. Each creamery supplied its cream-buying stations with equipment for making the filter test and placed milk strainers, milk and cream cans, and utensils on sale at cost. Farmers purchased more than 4,000 cream containers and several hundred milk strainers.

One of the large centralizing creameries reported that in 1932 at least one-third of the cream received was of such quality that the butter made from it would not score more than 88. At present this plant rejects cream that makes butter of less than 88 score, and 90 percent of its butter now scores higher than 88. Another creamery of this type reports that in 1932 not more than 15 percent of the cream received could be made into butter scoring as high as 90, while at present 40 to 50 percent of the cream received produces butter of that quality. It is estimated that 75 percent of the cream received at the local creameries can be made into butter that will score 90 or higher. One of the largest of these creameries received a score of 90 or higher on 82 percent of the butter shipped to eastern markets.

In the Tennessee master buttermaker's contest seven buttermakers competed in the required 6 scorings, 4 of the scorings being in Northern States where the butter was scored by northern judges. The winner's average score was 93.36 and the average of all 42 entries was 92.68. This indicates that some of the cream received at these creameries is of very fine quality and that the buttermakers are skilled in their trade.

The creamery-introduction work in South Carolina, Alabama, and Arkansas was terminated early in the year.

#### SWISS CHEESE INTRODUCTION IN WISCONSIN

Practically all the factories visited by the manufacturing specialist made Swiss cheese once a day. The cooling of the night's milk, therefore, was an important factor in determining the quality of the cheese. It was cooled on the farms or at the factories. The farmers cooled the milk in cans in tanks of cold water, or used tubular coolers. Observations indicate the latter method was more common. Morning's milk was cooled only by those farmers who delivered to large town factories, and then only in warm weather.

A certain amount of ripeness in the milk is desirable; and work to determine the best temperature to which to cool night's milk and the best means of cooling will aid in clearing up some of the problems encountered by the manufacturer of Swiss cheese. Where facilities permit, the better plan appears to be to pour the milk directly into properly cleaned cans and place the cans in a tank of cold running water where the milk can be cooled with occasional stirring. This procedure eliminates the cooler, which may not always be kept sanitary, and helps to prevent potential contamination of all the milk.



A number of factories having vats or kettles that hold 4,000 to 6,000 pounds of milk make a practice of having this much milk on hand before beginning clarification. Some of these factories are also equipped to warm the milk to a temperature of about 70° F. for clarification. That this additional holding and handling of the milk may not be undesirable is shown by the fact that the maker who produced the best cheese in the Monroe territory over a 4-year period followed these practices. At this factory the milk was delivered once a day and all the farmers had cooled the night's milk in tanks of cold water. Holding the milk caused it to work up quicker in the kettle and consequently the cheesemaker was able to get the desired condition of the curd for dipping, without delay or special effort. A number of factories have adopted the above arrangement of handling the milk prior to clarification, and an improvement in the quality of the cheese has resulted. However, a change to this arrangement does not always bring good results, as might be expected in view of the difference in flora and composition of milk.

All the cheesemakers who endeavor to obtain open cheese clarify their milk. A few have drilled holes in the clarifier disks so that a proportionate amount of the milk flows out as cream from the cream spout. The clarified milk flows into the kettle. If more cream comes from the cream spout than is necessary to effect the desired standardization the surplus is poured into the kettles. Machines may now be purchased which include a special feature for removing some of the fat. Openings in the top disk can be adjusted so as to remove the desired portion of the milk fat in the form of cream. A few cheesemakers separate only the amount of milk necessary to obtain the amount of skim milk needed for standardizing the kettle milk. After this milk is separated the bowl is stopped, the separator disks are replaced with clarifier disks, and the bowl is brought up to speed for clarifying the rest of the milk. The majority of the cheesemakers separate all the milk. They remove enough cream to effect standardization, then turn the cream spout so the cream flows into the same trough which conveys the skim milk into the kettle.

The second method results in the least loss of fat in the kettle whey and also the most uniform loss from kettle to kettle. This method is preferable to the third method, in which fat losses are least uniform and generally higher than in the first and second methods. However, the fat content of the whey when the milk is standardized by the first method is only slightly greater than when it is standardized by the second method. Any variation in the fat loss in the whey causes a variation in the fat content of the cheese.

Each factory presents an individual problem. This was strikingly demonstrated by standardization methods. Many of the cheesemakers standardized the milk according to the properties of the curd in the kettle and on the press. If the curd was spongy more fat was removed. A definite ratio of fat to casein resulted in a good curd at one factory, while at another factory the same ratio would not prevent the curd and green cheese from developing a spongy condition. How to overcome the spongy condition of the curd in the kettle and on the press without excessive standardization of the milk is a problem that must be solved before high-grade Swiss cheese can be made throughout the year.

It is impossible, with accepted cheese-factory methods and with the starters in use at present, to influence more than slightly the time of making in the kettle. Real improvement will come about by studying the cause of the slow-working milk and finding out how to obtain faster-working milk before the usual making processes in the kettle are begun.

A uniform temperature of 70° to 75° F. in the warm curing room is most desirable; uneven temperatures are responsible for some of the defects in Swiss cheese, such as checking and loss of fat. It is very difficult to control the temperature in the cold rooms without the aid of cooling equipment, especially when the weather is very warm or very cold. A number of operators have installed artificial refrigeration. This is a step in the right direction.

The cheeses are held at the factories 6 weeks during the months of April to August, inclusive, and for 8 weeks the remainder of the year. They are then taken to dealers' cold-storage rooms, where they are usually held at a temperature of 40° F. If the desired flavor has not developed before the cheese is moved to cold storage it may never do so, because changes in flavor take place slowly at low temperatures. More general use of artificial refrigeration to control temperatures at Swiss-cheese factories would enable the makers to hold the cheese longer for curing.

## SWISS CHEESE INTRODUCTION IN OHIO

During 1934, 54,400,000 pounds of milk was utilized in making culture Swiss cheese. This was 10,400,000 pounds more than was used in 1933. The culture Swiss cheese factories not only were able to offer the best outlet for surplus milk in their territory and to hold their producers in competition with other processors of milk, but they increased their receipts of milk 23.7 percent.

A record has been kept since 1931 of the amount and grades of cheese made at the culture factories. These data also show a desirable trend toward greater winter production. In the winter of 1934-35 only 4 of the 28 culture factories closed, whereas in the winter of 1929-30 only 4 of 20 continued to operate. While the amount of milk received at some of these factories dropped to a low level last winter, the fact that the factories remained open and so continued to give the farmers an all-year market will aid in bringing about greater winter milk production. Operators have been advised to encourage more winter milking, since it is easier to make high-quality cheese in cold weather than in warm summer months and higher prices can be paid for milk.

The properties of Swiss cheese are adversely affected by the use of poor starters, and there is still much work to be done before the cheesemakers will succeed in carrying starters in the right manner. Cheesemakers often fail to prepare medium properly, with the result that heat-resistant bacteria in it may have a detrimental effect. A relatively inexpensive water-bath incubator for carrying starters has been designed and has proved very satisfactory. The cabinet was made locally and the Bureau representative supervised the purchase of the electrical equipment and its installation. It was used for demonstration purposes, and several operators in Ohio and Wisconsin purchased incubators of this improved design. Operators both in Ohio and Wisconsin have been able to maintain the temperature of the bath within 1° of the desired temperature.

Many improvements were made in Ohio Swiss cheese factories in 1934. New modern plants have been built and others remodeled. This was due in part to the activity of State dairy inspectors. The operators have been aided by the Government specialists in an effort to obtain better operating arrangements. The general plan for the new factories is brick and concrete, with white tile facings in the work rooms. An effort is being made to have new factories equipped with modern can-dumping facilities so as to make it easier for the man who receives the milk to inspect it.

Experiences of the Bureau cheese specialist have served to demonstrate effective methods for improving the milk supply. At one factory where a demonstration project was carried on the milk was examined at regular intervals and each farmer was notified by a form letter of the results. Defects were described, also the methods for overcoming them. These letters brought about excellent results, especially when the producers realized that their milk would no longer be accepted if it continued to be unsatisfactory. If a farmer's milk was found to be unsatisfactory in three successive examinations he was requested to keep his milk at home for 3 days or until he could locate and correct the trouble. Assistance was furnished on request. Continued failure to deliver milk of the desired quality resulted in his being dropped permanently.

## CHEDDAR CHEESE INTRODUCTION

The regular work of assisting State extension men, cheese-factory operators, and cheesemakers in problems of manufacture and plant operation, which in recent years has been limited to Southern and Middle Western States, has resulted in a more uniform and higher grade of cheese. During the past year, at the request of cheese manufacturers and State extension officials, this type of work was also carried on in California, Oregon, and Idaho. The cheese specialist assisted at dairy-manufacturing short courses and acted as official judge of cheese at the National Dairy Products Judging Contest and at State fairs. He has given instruction and demonstrations in cooperation with home demonstration agents at meetings of farm women on the making of cheese on the farm, which has been recommended and encouraged during the past 4 years as a part of the live-at-home program.

The packaging, curing, and merchandising of American Cheddar cheese in cans, which was made possible by the Bureau's research laboratories, is being watched with a great deal of interest by cheese manufacturers and distributors. Under the supervision of this Division, several companies made



experimental packs which cured normally. Two companies have enlarged their operations and placed the canned cheese on the market. This development enables consumers to purchase natural Cheddar cheese in a sanitary, consumer-size package.

#### REGULATORY WORK

Packing-stock butter in all process-butter plants was of better quality from the standpoint of cleanliness this year than in preceding years. As a result of the Food and Drug Administration's activity in seizing filthy packing stock, jobbers and dealers kept their butter in better condition than heretofore. Manufacturers of process butter have all taken a greater interest in obtaining a cleaner product, and in the South particularly the stock is obtained much fresher than formerly so that less moldy or stale butter is used. Operators of process-butter factories also made noteworthy progress in improving their buildings and equipment, as well as the sanitary conditions, and processing methods. Recommendations made by this Division or by the cooperating meat-inspection officers were readily complied with. The two largest plants now melt, strain, and clarify surplus packing stock received during summer months and store the fat instead of the packing stock as has been the custom heretofore. This practice tends to result in a better finished product because there is less deterioration in fat during storage than in butter.

The total amount of process butter manufactured during the fiscal year was 1,835,551 pounds, as compared with 1,229,166 pounds the preceding fiscal year.

As pointed out in last year's report, existing laws and regulations pertaining to process or renovated butter need to be clarified. Likewise, the need for proper administration of laws pertaining to inspection of all dairy products intended for export is emphasized by the findings of this Division. Steps have been taken toward strengthening the regulatory work as it relates to dairy products intended for export, as well as to the manufacture of process or renovated butter.

#### EDITORIAL AND INFORMATION WORK

L. S. RICHARDSON, *in charge*

During the year 13 publications were printed, 11 of which were new and 2 were revisions of existing publications. At the end of the year 7 manuscripts were being prepared for publication. Seventeen bulletins were also reprinted during the year. These publications and manuscripts represent the various research and service activities of the Bureau and are both scientific and popular in character.

Forty articles prepared by members of the Bureau were published in dairy and agricultural publications and in scientific journals outside the Department, and five articles were contributed to the 1935 Yearbook of Agriculture. Members of the Bureau also collaborated with the Bureau of Animal Industry in the preparation of a manuscript for a Farmers' Bulletin on Livestock for Small Farms.

Fourteen publications covering subjects of an emergency nature or of pressing interest to the dairy industry were issued in mimeograph form, and 19 news releases covering the activities of the Bureau were issued through the Department Press Service. Assistance was given in the preparation and delivery of 33 radio broadcasts on dairy subjects through the Department Radio Service, and information was supplied to the Extension Service for the revision of several lantern-slide and film-strip series. The Bureau also cooperated with the Office of Exhibits in revising exhibits for State and interstate fairs, and in preparing new exhibits for the San Diego Exposition at San Diego, Calif.

## PUBLICATIONS

The following articles and Department publications written by workers in the Bureau were issued during the fiscal year:

## FEEDING AND NUTRITION

- Carotene and vitamin A in the nutrition of dairy calves. H. T. Converse and E. B. Meigs. U. S. Dept. Agr., Bur. Dairy Indus. BDIM-645. [Mimeographed.]
- Vitamin A value of plant feeds fully accounted for by their carotene content. E. B. Meigs. U. S. Dept. Agr. Yearbook 1935: 324-326.
- The decomposition of carotene during the storage of hays and meals. (Abstract of paper.) E. A. Kane and L. A. Shinn. Jour. Biol. Chem. 109 (2): xlviii-xlix.
- The relation between the color and vitamin A of butter and the feed of the cow. H. T. Converse, H. G. Wiseman, and E. B. Meigs. Amer. Soc. Anim. Prod. Proc. 27: 50-54. 1934.
- Variations in the carotene content of farm feeds. L. A. Shinn, E. A. Kane, H. G. Wiseman, and C. A. Cary. Amer. Soc. Anim. Prod. Proc. 27: 190-192. 1934.
- The color and carotene content of various home-grown roughage rations and the influence of these rations on the color, carotene, and vitamin A potency of the butterfat. (Abstract of paper.) R. E. Hodgson, J. C. Knott, H. K. Murer, and R. R. Graves. Jour. Dairy Sci. 18: 433-434. (With Wash. Agr. Expt. Sta.)
- Effect of the condition of corn plant at cutting upon the carotene content of silage. (Abstract of paper.) E. A. Kane and C. A. Cary. Jour. Dairy Sci. 18: 437.
- The stack silage method of preserving forage crops and the comparative nutritive value of oat and pea silage made in a stack and in a tower. (Abstract of paper.) J. C. Knott, R. E. Hodgson, and R. R. Graves. Jour. Dairy Sci. 18: 438. (With Wash. Agr. Expt. Sta.)
- Keeping quality of baled corn stover, as affected by moisture content of the stover and density of the bale. J. B. Shepherd, T. E. Woodward, and R. R. Graves. U. S. Dept. Agr., Bur. Dairy Indus. Roughage Feed, Ser. 4, BDIM-650. [Mimeographed.]
- Experimental methods with dairy cattle. R. E. Hodgson. 7th Ann. State Col. Wash. Inst. Dairying Proc.: 94-102. 1934.
- Pasture and pasture management. R. E. Hodgson. 8th Ann. State Col. Wash. Inst. Dairying Proc.: 120-124. 1935.
- Roughage feeding investigations, feeding yearling heifers—progress report. J. A. Simms. Abs. Papers, Ann. Meeting. South. Div. Amer. Dairy Sci. Assoc. in conjunction with Ann. Conv. Assoc. South. Agr. Workers 1935: 22.
- Heavy cottonseed meal feeding in relation to udder troubles in dairy cows. R. P. Hotis and T. E. Woodward. U. S. Dept. Agr. Tech. Bull. 473.
- Feeding dairy cows with and without grain. W. F. Dickson and D. V. Kopland. Mont. Agr. Expt. Sta. Bull. 293. (In cooperation.)
- Milk and butterfat production on high and low protein rations. (Abstract of paper.) C. A. Cary. Jour. Dairy Sci. 18: 445.
- Artificial drying provides means of preserving feeding value of immature grasses. R. E. Hodgson. U. S. Dept. Agr. Yearbook 1935: 123-125.
- Effect of temperature of artificial drying on digestibility and availability of nutrients

- in pasture herbage. R. E. Hodgson, J. C. Knott, R. R. Graves, and H. K. Murer. Jour. Agr. Research 50: 149-164. (With Wash. Agr. Expt. Sta.)
- Seasonal variations in carrying capacity of pastures for dairy cows in milk. T. E. Woodward and R. R. Graves. U. S. Dept. Agr. Tech. Bull. 465.
- Feeding cattle in the drought regions. E. B. Meigs. U. S. Dept. Agr., Bur. Dairy Indus. BDIM-644. [Mimeographed.]

## BREEDS AND BREEDING

- An unfertilized tubal ovum in the cow. E. I. Evans and F. W. Miller. Anat. Rec. 62: 25-30.
- Results of transplanting gonadal tissue in dairy cows and bulls. F. W. Miller, R. R. Graves and G. T. Creech. Jour. Agr. Research 49: 259-278. (With Bur. Anim. Indus.)
- Artificial insemination. F. W. Miller. Rept. Proc. 54th Ann. Conv. Conn. Dairymen's Assoc.: 102-105. 1935.
- Some features of the work of the Federal dairy field stations. J. R. Dawson. Abs. Papers, Ann. Meeting South. Div. Amer. Dairy Sci. Assoc. in conjunction with Ann. Conv. Assoc. South. Agr. Workers 1935: 20-21.

## HERD MANAGEMENT AND IMPROVEMENT

- Standardized lactation records for reporting dam and daughter comparisons in D. H. I. A. (Abstract of paper.) J. F. Kendrick. Jour. Dairy Sci. 18: 489.
- Dairy-herd improvement facilitated by testing cows year after year. J. C. McDowell. U. S. Dept. Agr. Yearbook 1935: 165-167.
- Suggestions for stepping up dairy extension work [in 12 Eastern States]. J. B. Parker. U. S. Dept. Agr. Ext. Serv. (In cooperation. Mimeographed.)
- Suggestions for stepping up dairy extension work [in 13 North Central States]. A. B. Nystrom. U. S. Dept. Agr. Ext. Serv. (In cooperation. Mimeographed.)
- Suggestions for stepping up dairy extension work [in 11 Western States]. R. C. Jones. U. S. Dept. Agr. Ext. Serv. (In cooperation. Mimeographed.)
- A yearly association program. (Abstract of paper.) A. B. Nystrom. Jour. Dairy Sci. 18: 483-484.
- A new disease of dairy cattle. S. L. Cathcart. Abs. Papers South. Div. Amer. Dairy Sci. Assoc. in conjunction with Ann. Conv. Assoc. South. Agr. Workers 1935: 23.

## MILK AND CREAM

- Comparison of bacteriological samples taken from cans and weigh tanks. E. Kelly. Proc. 27th Ann. Conv. Internatl. Assoc. Milk Dealers, Lab. Sec. 1934: 65-75.
- The effect of homogenization on certain characteristics of milk. C. J. Babcock. U. S. Dept. Agr. Tech. Bull. 438.
- Cooling milk on the farm with small mechanical outfits. R. P. Hotis and J. R. McCalmont. U. S. Dept. Agr. Circ. 336. (With Bur. Agr. Engin.)
- High-quality cream for buttermaking is easily produced by following 3 important steps. U. S. Dept. Agr. Misc. Pub. 213.



## CHEMISTRY AND BACTERIOLOGY

- The lipids of milk. I. The fatty acids of the lecithin-cephalin fraction. F. E. Kurtz, G. S. Jamieson and G. E. Holm. *Jour. Biol. Chem.* 106: 717-724. (With *Bur. Chem. and Soils.*)
- The action of milk fat as a foam depressant. A. Leviton and A. Leighton. *Jour. Dairy Sci.* 18: 105-112.
- The spectrophotometric determination of carotene in butter fat. (Abstract of paper.) H. G. Wiseman and C. A. Cary. *Jour. Biol. Chem.* 109 (2): ci-cii.
- An apparatus for electro dialysis. P. D. Watson and P. N. Peter. *Rev. Sci. Instruments* 5: 362-365.
- The special reactivity of peptides. B. H. Nicolet. *Science* 81: 181-182.
- Some derivatives of  $\alpha$ ,  $\alpha$ -bis-benzoylamino-propionic acid. B. H. Nicolet. *Jour. Amer. Chem. Soc.* 57: 1073.
- The addition of mercaptans to certain double bonds. B. H. Nicolet. *Jour. Amer. Chem. Soc.* 57: 1098-1099.
- The formation of unsymmetrical acid amides. B. H. Nicolet. *Jour. Amer. Chem. Soc.* 57: 1064-1065.
- The nature of ropy milk. Report no. 1. Bacteriological problems in milk plants. L. A. Rogers, J. M. Sherman and E. G. Hastings. *Internatl. Assoc. Milk Dealers Assoc. Bull.* 23. (With N. Y., Cornell Agr. Expt. Sta. and Wis. Agr. Expt. Sta.)
- The influence of some environmental factors upon thermal resistance of bacterial spores. H. R. Curran. *Jour. Infect. Diseases* 56: 196-202.
- A probable mechanism for the biochemical synthesis of methionine. B. H. Nicolet. *Abs. Papers Amer. Chem. Soc. Div. Biol. Chem.* 1. 1934.
- The relationship of oxidation reduction systems to antioxygenic action. G. R. Greenbank and G. E. Holm. *Abs. Papers Amer. Chem. Soc. Div. Phys. and Inorgan. Chem.* 4. 1934.

## BUTTER AND CHEESE

- Suggestions for improving the creamery butter industry. U. S. Dept. Agr., *Bur. Dairy Indus.* BDIM-641. [Mimeographed.]
- Packaging American cheese in cans. L. A. Rogers. *Food Indus.* 6: 308-309, 338.
- Packaging, curing, and merchandising American Cheddar cheese in cans. H. L. Wilson. *U. S. Dept. Agr. Circ.* 352.
- Making American cheese on the farm for home consumption. H. L. Wilson. *U. S. Dept. Agr. Farmers' Bull.* 1734.
- Cheese industry being developed in Southern States. H. L. Wilson. *Nat. Butter and Cheese Jour.* 26 (2): 30, 32.
- Points in operation of incubators in Swiss cheese factories. R. E. Hardell. *U. S. Dept. Agr., Bur. Dairy Indus.* BDIM-660. [Mimeographed.]

- Preparing starter media at Swiss-cheese factories. R. E. Hardell. *U. S. Dept. Agr., Bur. Dairy Indus.* BDIM-654. [Mimeographed.]
- The bacteriology of Swiss cheese. II. Bacteriology of the cheese in the press. W. C. Frazier, L. A. Burke, A. J. Boyer, G. P. Sanders, and K. J. Matheson. *Jour. Dairy Sci.* 18: 373-387.
- Variations in physical properties of milks. (Abstract of paper) G. P. Sanders, K. J. Matheson and L. A. Burke. *Jour. Dairy Sci.* 18: 456-457.
- The manufacture of a soft cheese of the Bel Paese type. (Abstract of paper) R. R. Farrar. *Jour. Dairy Sci.* 18: 476-477.

## ICE CREAM

- The significance of physical measurements in ice cream. A. Leighton. *Rept. Proc. 34th Ann. Conv. Internatl. Assoc. Ice Cream Manfrs.* 2: 77-81. 1934.
- The apparent viscosity of ice cream. I. The sagging beam method of measurement. II. Factors to be controlled. III. The effects of milkfat, gelatin, and homogenization temperature. A. Leighton, A. Leviton, and O. E. Williams. *Jour. Dairy Sci.* 17: 639-650.
- Compressing hardened ice cream affords a ready means for making a product of uniform density. O. E. Williams. *U. S. Dept. Agr., Bur. Dairy Indus.* BDIM-655. [Mimeographed.]

## BYPRODUCTS

- Dried skim milk added to other foods improves their nutritive value. G. E. Holm. *U. S. Dept. Agr. Yearbook* 1935: 171-174.
- Milk sugar produces more rapid growth in young animals than cane sugar. O. E. Whittier. *U. S. Dept. Agr. Yearbook* 1935: 261-262.
- The effects of lactose on growth and longevity. E. O. Whittier, C. A. Cary, and N. R. Ellis. *Jour. Nutrition* 9: 521-532. (With *Bur. Anim. Indus.*)
- Color development in lactose solutions during heating with special reference to the color of evaporated milk. B. H. Webb. *Jour. Dairy Sci.* 18: 81-96.
- Some physical effects of freezing upon milk and cream. B. H. Webb and S. A. Hall. *Jour. Dairy Sci.* 18: 275-286.

## MISCELLANEOUS

- Report of the chief of the Bureau of Dairy Industry for the fiscal year ended June 30, 1934. O. E. Reed. *U. S. Dept. Agr., Bur. Dairy Indus.*
- The dairy situation. O. E. Reed. *Rept. Proc. 34th Ann. Conv. Internatl. Assoc. Ice Cream Manfrs.* 1: 34-41. 1934.
- Developing a satisfactory dairy industry. O. E. Reed. *Pacific Rural Press* 129: 570.











# REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE,  
*Washington, D. C., September 16, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the work of the Bureau of Entomology and Plant Quarantine for the fiscal year ended June 30, 1935.

Sincerely yours,

LEE A. STRONG, *Chief.*

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## INTRODUCTION

In accord with the reorganization directed by the Secretary and approved by Congress, the investigational work on insects previously carried on in the Bureau of Entomology and the activities concerned with control and eradication of plant pests and the enforcement of plant quarantines previously carried on in the Bureau of Plant Quarantine, together with the functions concerned with the control and eradication of plant diseases directed by the Bureau of Plant Industry, were consolidated at the beginning of the fiscal year into the newly created Bureau of Entomology and Plant Quarantine. Effective September 1, the chemical work on insecticides and fungicides previously carried on in the Bureau of Chemistry and Soils was transferred, by order of the Secretary, to the Bureau of Entomology and Plant Quarantine. These investigations on the chemistry of insecticides continued under the direction of R. C. Roark as leader of the Division of Insecticide Investigations. The unfortunate and untimely death of Karl F. Kellerman, who had charge of the Division of Plant Disease Control of the Bureau of Entomology, was followed by the reassignment of certain activities previously carried on in that unit. Stanley B. Fracker, who had been in charge of the Division of Domestic Plant Quarantines of the Bureau of Plant Quarantine, was designated as leader of the Division of Plant Disease Control and the scope of the Division restricted to work concerned with the control and prevention of spread of white pine blister rust and black stem rust of small grains. B. M. Gaddis was placed in charge of the Division of Domestic Plant Quarantines and the scope of the Division enlarged to include activities on the control and prevention of spread of the phony peach disease and citrus canker. The field direction of the work on the eradication of the Dutch elm disease was assigned to L. H. Worthley, who continued as field leader in charge of work on control and prevention of spread of the Japanese beetle and certification of products to meet the requirements of Federal and State quarantines on this pest, the gypsy, brown-tail, and satin moths, and the European corn borer. Investigations on the physiology and toxicology of insects, handled as a unit in the Bureau of Entomology, were consolidated with those concerned with the commercial application of control measures in the Bureau of Plant Quarantine, under the direction of L. A. Hawkins. The service and investigational work on insects attacking shade trees was assigned to the Division of Forest Insect Investigations.

During the fiscal year the regular and special activities concerned with the control and prevention of spread of the gypsy moth, the eradication of bar-

berry as an aid in combating black stem rust, and the control and prevention of spread of white pine blister rust, were financed under allotments of emergency funds rather than being provided for in the regular appropriations made for the work of the Bureau. Special allotments of emergency funds were also made available to aid in the eradication of the Dutch elm disease and measures to suppress an infestation of the Japanese beetle discovered at St. Louis, Mo.

## INSECT PEST SURVEY AND INFORMATION

During the year the Survey added to the permanent files of information on the distribution and abundance of insects over 12,000 notes on American insect pests and over 7,000 on insect pests of other countries, bringing the total number now available for consultation to over 226,000. A new feature of the mimeographed Insect Pest Survey Bulletin was started by issuing supplemental numbers as an avenue for the publication of more extensive and detailed survey reports on special subjects, such as *The Species and Distribution of Grasshoppers Responsible for the 1934 Outbreak*, and *Insect Notes from Costa Rica in 1934*.

During the year, 116 articles covering various phases of the activities of the Bureau were released to the press. A complete program for radio releases was prepared for the year and 39 talks were put on the air. The use of film strips as a means of visual education has been very greatly stimulated during the year. The construction of a comprehensive exhibit on the activities of the Bureau, to be shown at the San Diego Exposition, was planned and supervised. During the year over 100,000 publications were distributed, exclusive of those sent out on regular mailing lists and miscellaneous mimeographed material prepared from time to time.

## FRUIT INSECT INVESTIGATIONS

### APPLE INSECTS

The major portion of the funds available for the work on apple insects, including a special allotment made by the Public Works Administration, was used for investigations on the codling moth in an effort to develop a satisfactory and practical means of controlling the insect that does not result in objectionable residues at harvest time.

The large-scale tests of various insecticides carried on during the calendar year 1934 at numerous points indicated that lead arsenate is still the most generally satisfactory material available, although not fully effective in the control of severe infestations. Closely approaching lead arsenate in effectiveness was the nicotine-oil treatment, which, however, involves certain difficulties in practical use. The fixed nicotine materials, nicotine bentonite and nicotine tannate, gave indications sufficiently favorable to warrant the hope that a practical insecticide may exist somewhere in this group of materials. Mixtures of ground derris, cube, and pyrethrum with kaolin, applied as sprays, were ineffective for codling moth control. Laboratory studies to develop new and less objectionable insecticidal compounds, preliminary to more extensive field experimentation with the more promising materials, were continued. During the 1935 season extensive tests are being made with phenothiazine, a material which is made by fusing sulphur with diphenylamine. This compound was first prepared by the Insecticide Division, and in laboratory experiments in 1934 it was found to be very toxic to codling moth larvae. Preliminary results of both field and laboratory experiments in the season of 1935 are very encouraging, although, when combined with mineral oil and with soybean oil, the material has caused serious injury. Much further field work is of course needed before the exact possibilities and limitations of this material can be determined.

The large-scale experiment conducted in 1934 in southern Indiana in which one-half of a 40-acre orchard was thoroughly cleaned up and banded indicated that these practices reduced the injury to the fruit by the codling moth by 30 to 50 percent, thus furnishing experimental proof of the soundness of the present recommendations. Experiments with orchard sanitation and banding are being carried on in southern Indiana, West Virginia, Washington, and Oregon, and include detailed experiments with banding to determine the exact load of the chemical mixture needed for full effectiveness under conditions existing in various regions.



In cooperation with the Yakima, Wash., Fruit Growers Association, experiments have been carried on with the sterilization of orchard boxes and other containers. By passing them through live steam in an insulated wooden tunnel, it was found entirely feasible to kill practically all codling moth larvae at a cost of \$0.75 to \$2 per thousand for packing boxes, and at a cost of \$1 to \$2.67 per thousand for cannery lug boxes.

The large-scale bait-trap experiment conducted at Orleans, Ind., in 1934 indicated that the traps and materials now available will reduce the infestation by about 25 percent. Further studies of the use of baits and bait traps, in the hope of developing sufficiently effective materials and traps for use in direct control, are under way at Vincennes, Ind., and Yakima, Wash. Fundamental studies of the reaction of moths to lights are under way at Geneva, N. Y., in cooperation with the New York Agricultural Experiment Station, and large-scale tests of light traps are being carried on at Orleans, Ind., in cooperation with the Indiana Agricultural Experiment Station.

Further experiments with the control of the codling moth by the use of parasites are under way. The mass liberations of the egg parasite *Trichogramma minutum* Riley, made in 1934 at Yakima, Wash., and Cornelia, Ga., did not result in any appreciable reduction in the codling moth population. The egg-larval parasite *Ascogaster carpocapsae* Vier. has been introduced into a number of western and southwestern localities where it did not previously occur.

At Wooster, Ohio, tests are being conducted to determine the effect of oils, and of insecticidal materials that may be added to them, on hibernating larvae of the codling moth. Certain grades of pine-tar oil used at a strength of 50 percent appear to be effective and are more toxic than are other oils tested.

#### PEACH INSECTS

The station at Fort Valley, Ga., has continued its efforts to develop a satisfactory substitute for lead arsenate for the control of the plum curculio on peaches. Fluorine compounds tested during the early summer of 1935 caused serious injury to the fruit. This injury, which appeared to an equal extent on trees sprayed with barium fluosilicate, with synthetic cryolite, and with natural cryolite, was sufficiently severe to rule out these materials for use on peach trees.

Further studies of the effect of lime-sulphur, applied during the dormant period for the control of the San Jose scale, have revealed the fact that mortality counts made within a month or two after the spraying are very misleading and that, for full information on the effect of lime-sulphur, it is necessary to delay the examination for 4 or 5 months.

The rearing and liberation of imported parasites of the oriental fruit moth have been continued. Some 216 colonies, chiefly of foreign parasites, containing 45,000 parasites, have been released by the workers of the Moorestown, N. J., laboratory in various peach-producing sections in 13 Eastern and Middle Western States. Recovery collections have indicated that the general level of parasitization is increasing, although there has not yet been time for the general establishment of many of the foreign parasites that have been liberated.

The investigations of baits and bait traps for the control of the oriental fruit moth have been transferred from Cornelia, Ga., to Moorestown, N. J., where much better facilities are available for the work.

#### GRAPE INSECTS

Numerous possible substitutes for lead arsenate have been tested against the grape berry moth at Sandusky, Ohio. This insect appears to be more readily controlled than the codling moth, and satisfactory control was obtained with nicotine bentonite, nicotine tannate, nicotine sulphate with mineral oil, and mixtures of ground pyrethrum with kaolin. For the most part these mixtures cannot be used in a practical way, however, as they apparently affected the fruit unfavorably. The mixtures which included kaolin and bentonite left very unsightly deposits on the grapes, which, although non-poisonous, made the fruit practically unsalable. There is a possibility, however, that the use of certain of these clays may prove unobjectionable, or even advantageous, on grapes produced for juice. Mixtures containing oil removed the bloom from the berries, giving them a very unattractive appearance.

Experiments with burning for the control of the grape berry moth during the winter period, carried on in cooperation with the Bureau of Agricultural Engineering, have indicated rather clearly that this practice is not feasible as a means of control. Burning over the margins of vineyards, however, offers considerable promise in reducing the hibernating populations of the grape leaf hoppers (*Erythroneura comes* Say and related species).

#### NUT INSECTS

Further experiments in the control of the pecan nut case bearer (*Acrobasis caryae* Grote) in the Brownwood, Tex., area have confirmed earlier work, indicating a control of 95 percent or better from two applications of lead arsenate at a strength of 3 pounds per 100 gallons, made in the latter part of May or early in June, during the period of activity of first-brood larvae. A single application gave a control of 75 percent or more. The addition of zinc sulphate or fish oil to the lead arsenate appeared to have comparatively little influence on its effectiveness. Two applications of three-fourths of 1 percent summer oil with nicotine sulphate (1 to 1,000) gave a control of more than 95 percent under Texas conditions, confirming similar results which have been obtained in the vicinity of Albany, Ga. A single application gave results nearly as good. A number of commercial growers in central Texas have been impressed by the results obtained in nut case bearer control and are installing the necessary spray equipment.

The liberations of *Trichogramma minutum* during 1935 for the control of the pecan nut case bearer near Albany, Ga., have resulted in some reduction in infestation in certain orchards; in others the results have been inconclusive, largely because of the lightness of the infestation. Small-scale experiments in 1934 with the use of this parasite for the control of the leaf case bearer (*Acrobasis palliolella* Rag.) gave an apparent reduction of about one-third of the infestation.

Experiments in the control of the obscure scale conducted near Shreveport, La., have indicated further the susceptibility of pecan trees to injury from the use of oil sprays. It appears that the oils should be used with great caution on trees low in vigor.

#### DRIED-FRUIT INSECTS

At the Fresno, Calif., laboratory studies have been made of devices for reducing infestation in dried raisins by the raisin moth (*Ephestia figulilella* Greg.). It has been found possible to remove a substantial portion of the insects from raisins on ranches by passing the fruit over a specially built shaking and screening device. With certain varieties a reduction of more than 90 percent has been accomplished. With others the results have been less favorable and indicate the need of further adaptation.

In preliminary experiments, a sealing mixture consisting of glucose and gelatin, applied to Adriatic figs by means of a gasoline-powered paint sprayer, has given excellent protection from field infestation by the dried-fruit beetle which infests growing fruit, contributing to the spoilage of figs by various micro-organisms. With Calimyrna figs this practice appears to be of less value, since it is necessary to delay the sealing until the figs have been pollinated by *Blastophaga*.

The workers of the Fresno station have cooperated with representatives of the Bureau of Plant Industry in efforts to develop means of producing endosepsis-free *Blastophaga* in order that these pollinating insects may be introduced into areas in which they are needed, without at the same time introducing endosepsis and other fig diseases.

#### SUBTROPICAL FRUIT INSECTS

The Orlando, Fla., station has continued its experiments with various adhesives for use with sulphur sprays and dusts for the control of the citrus rust mite. Of the materials tested thus far, preliminary reports indicate the most promise for blood albumen and aluminum sulphate.

The Orlando station has also conducted experiments in cooperation with the Bureaus of Plant Industry and Chemistry and Soils to determine the effect of tartar emetic on citrus trees when applied in small quantities in a sweetened spray mixture. Repeated applications of a drenching spray con-



taining 8 pounds of tartar emetic and 5 gallons of molasses in 100 gallons of spray have caused severe injury. Mist sprays of the same mixtures, on the other hand, have not caused appreciable injury. No effect on fruit composition has been observed thus far. Similar experiments have been conducted in the Rio Grande Valley with the cooperation of the Division of Mexican Fruit Fly Control, with similar results.

Further extensive work is being carried on by the Whittier, Calif., station with the control of the citrus thrips (*Scirtothrips citri* Moulton). A number of materials other than sulphur are being tested this season, including dusts containing rotenone, zinc sulphate, pyrethrum, and zinc oxide. Tests are also under way with bentonite and blood albumen as stickers for sulphur dusts.

The Whittier station has continued to obtain data on the biology of the California red scale as a basis for a study of the resistance of this insect to fumigation with hydrocyanic acid gas.

### FRUIT FLIES

Investigations on various fruit flies that are potential pests to fruit culture in the continental United States have been continued at laboratories in Honolulu, Hawaii; Mexico City, Mexico; Mayaguez, Puerto Rico; and Balboa, Canal Zone.

In Honolulu studies to determine the effects of high and low temperatures on the immature stages of the Mediterranean fruit fly in various host fruits have received special attention. Hundreds of thousands of larvae and thousands of infested fruits have been used in these tests. These have centered around the time interval required at 31° to 32° and 108° to 112° F. Laboratory and field studies have also been made to determine the effect a wide variety of poisons may have on adults when used in sweetened sprays. Among the materials tested were various nicotine compounds, copper arsenite, copper tartrate, copper sucate, and certain salts of cadmium. Some of these are more effective than lead arsenate but none were as toxic as tartar emetic. Experiments to develop and determine the usefulness of different types of traps and baits in controlling and detecting the presence of adults have been continued, special attention being directed to those containing or releasing ammonia.

At Mexico City, attention has been directed principally to baits and poisons for the Mexican fruit fly (*Anastrepha ludens* Loew) and related forms of *Anastrepha*. The studies on baits indicate that a product of the metabolism of yeast or other organisms presents one of the attractive principles. Copper compounds, particularly copper sucate, have shown a high degree of toxicity, and a special study has been made of them. Attention has also been given to determine the host preference of various fruit flies occurring in Mexico and to experiments to determine the effect of climatic factors, especially low temperatures, on survival. Adults of both *A. ludens* and *A. serpentina* Wied. survived in outdoor air temperatures as low as 22° F., but both are killed when exposed to temperatures reaching a minimum of 14° for a period of 7½ hours. *A. ludens* appears to be more resistant to low temperatures than does *A. serpentina*.

At Mayaguez, Puerto Rico, the studies have been concerned with *Anastrepha acidusa* Walker and *A. suspensa* Loew and have consisted principally of tests to determine host relations and the effectiveness of various poisons and baits under Puerto Rico conditions.

Twenty-two species of fruit flies are known to occur in the Canal Zone, and work at the Balboa laboratory has been concerned principally with the determination of facts on the habits and host preferences of the various species.

### PHONY PEACH DISEASE CONTROL

The phony peach disease, a virus disease intercommunicable among peach, plum, apricot, almond, and several other species, is known to have existed in peach plantings in Georgia for more than 50 years. It was not, however, until about 1920 that serious economic damage occurred. The disease is now recognized as a potential menace to the commercial growing of peaches in this country. The limited amount of scouting from 1926 to 1934 showed that the disease had spread to other States, and it is now known to be wide-spread throughout Georgia, Alabama, Mississippi, Louisiana, eastern Texas, and northern Florida, and scattered in South Carolina, Tennessee, and Arkansas. A few cases have been found in North Carolina, Missouri, and Illinois, and in

1932 one phony tree was found in southern Oklahoma. Since 1929 this Bureau has undertaken the prevention of the spread of the phony peach disease through the movement of nursery stock from infected nurseries. The closely coordinated eradication project that had been carried on by the Bureau of Plant Industry since 1929 was transferred to the Bureau of Entomology in December 1933, and both activities were consolidated the following year into a unified project with field headquarters at the Department's Peach Disease Laboratory, Fort Valley, Ga.

During the period from 1929 to the fiscal year 1935, inclusive, 589,290 trees in commercial and home orchards in 13 States were found infected and destroyed, in addition to eradications under the Civil Works Administration and nursery-inspection work. All the evidence obtained during this period indicates that economic control is practicable under the method employed.

The eradication work in orchards during the fiscal year 1935 is given in table 1.

TABLE 1.—*Commercial orchards and home properties inspected by Federal and State inspectors in cooperation to determine the presence or absence of phony peach disease, fiscal year 1935*

State	Commercial orchards				Home orchards and escaped trees				Total phony trees
	Properties		Trees		Properties		Trees		
	In-spected	Phony	Inspected	Phony	In-spected	Phony	In-spected	Phony	
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Georgia.....	945	615	5,017,209	96,954	1,627	533	46,491	2,014	98,968
Alabama.....	3	2	1,300	2	299	24	9,937	68	70
Arkansas.....	78	17	371,705	27	6	0	100	0	27
Delaware.....	51	0	154,305	0	250	0	1,545	0	0
Louisiana.....	76	51	63,652	2,183	5,210	285	47,265	1,162	3,345
Mississippi.....	25	9	28,293	395	540	25	4,975	49	444
North Carolina.....	22	1	80,292	5	1,212	19	11,586	24	29
South Carolina.....	18	1	38,425	2	133	0	3,253	0	2
Tennessee.....	32	1	113,525	1	972	10	9,776	25	26
Texas.....	14	7	23,857	20	25	3	452	6	26
Total.....	1,264	704	5,892,563	99,589	10,274	899	135,360	3,348	102,937

The data in table 1 show that in commercial orchards 1.69 percent of the trees inspected were found to be infected with the phony peach disease and that in the home orchards 2.47 percent were so infected.

A new plan of action was put into effect at the beginning of the 1935 field season for the purpose of obtaining definite information as to the extent of inspection and the scope of the control problem. For this purpose, four specific lines of activity were determined upon: (1) In the Gulf area where infection is prevalent to the extreme western limitation of peach production, nursery-environs inspection is receiving first consideration as a preventive measure against long-distance spread; (2) inspection and eradication of diseased trees in orchards in this area is also undertaken, the commercial areas receiving principal attention; (3) in the lightly infected States of North Carolina, South Carolina, Tennessee, Arkansas, Oklahoma, Missouri, and Illinois, it is the aim to eradicate all known infected trees, thus preventing, if possible, the northward spread of the disease into new areas; (4) a general survey of peach-growing areas of Delaware, New Jersey, Maryland, Virginia, West Virginia, Kentucky, Ohio, and Indiana is under way to find and destroy any scattered infections that might be present in this region not heretofore known to be infected. This survey will also include those parts of the lightly infected States not now known to be infected with phony peach disease.

During the year assistance was given to States in their efforts to determine the status of the disease in and adjacent to peach-growing nurseries and to develop practicable methods of culling borer-infested and borer-injured trees. The absence of the disease within a 1-mile radius of nurseries, or culling at digging time, is a certification requirement placed by many States in which the peach industry is of economic importance. Federal assistance in this work is



strictly limited to the development of practicable methods and the dissemination of such information. Diseased trees found in the course of inspection are removed by State inspectors and owners. Orchardists also willingly furnished labor for the destruction of infected trees. In the summer of 1934, after the beginning of the fiscal year, 137 nurseries in 10 infected States were inspected, and more than 300 phony trees in the 1-mile zone were found and removed. In the summer of 1935, 30 nurseries had been inspected up to July 1 and 124 infected trees found in the environs and destroyed.

Many peach growers in Georgia recently expressed confidence that the eradication of escaped peach trees conducted by the Civil Works Administration in the winter of 1933-34, in clearing out wild and abandoned peach trees, had done much toward solving the problem of phony peach disease control. Other growers have commented on the noticeable decrease in the number of curculios infesting trees in orchards so protected, as compared with those not protected. A similar project has been approved for the fiscal year 1936, to be carried on emergency relief funds, for the purpose of destroying wild host plants, chiefly escaped peaches and abandoned orchards, thus removing these reservoirs of regional infection that hamper the regular orchard eradication activities.

### CITRUS CANKER ERADICATION

The citrus canker eradication campaign is unique in character in that it is the first instance of the use of Federal funds appropriated specifically for the eradication of a plant disease. Despite the skepticism of many specialists who, at the time the work was inaugurated 20 years ago, regarded the effort as foredoomed to failure, the citrus industry has been protected from the ravages of this destructive disease. The effectiveness of this campaign is definitely proved by the fact that although canker was found on 515 properties in Florida, scattered through 26 counties, and approximately 3,000,000 citrus trees were destroyed because of the disease, no citrus canker has been reported since 1927 in this extremely important citrus-producing State.

During the years from 1915 to June 30, 1933, citrus canker eradication activities were maintained cooperatively with the States of Florida, Alabama, Louisiana, Mississippi, and Texas, and Federal supervision was delegated to the Bureau of Plant Industry until December 1, 1933, when it was transferred to the Bureau of Entomology. During 1934 cooperative inspection work was limited to Louisiana and Texas in areas where incipient infections were known to persist.

In the fiscal year 1935 the project was reorganized and a Bureau representative assigned to direct activities in the field in cooperation with the State officers. Such field contact gave impetus to the work from the start. A methodical drive was centered in the Galveston area of Texas to search for infection in wild or abandoned trees in wooded bayous, along roadsides, or in nurseries or home plantings. Due to infections developing in relatively young plantings in this area from time to time it was obvious that somewhere in the vicinity lingered undiscovered infected trees and the task was to find and destroy them. From the beginning of the drive in January 1935 to the close of the fiscal year from 2 to 4 inspectors working this area found citrus canker on 31 properties. All infected trees, totaling 606, and exposed trees, totaling 5,728, were destroyed under State authority. All citrus trees located in the day's work were plotted on a map for use in the event of the approval of more extensive eradication under an emergency relief project. Limited scouting during the year failed to disclose any infection in the commercial area of the lower Rio Grande Valley or the citrus-growing areas of Mississippi and Alabama. In Louisiana citrus canker was found in three parishes during the summer of 1934. The 14 infected trees and 32 other exposed trees were destroyed and, although grove and fruit inspection has been continued in the intervening months, no further infection has been discovered in that State. There were 218,904 trees inspected in Louisiana from July to December 1934. In Texas the inspection of 829,775 trees in 16 counties during the first half of the fiscal year disclosed 20 infected trees on 2 properties in the Galveston area. These were destroyed.

An extremely important and encouraging factor in the campaign is the recent approval of an emergency relief project to destroy abandoned and escaped citrus trees throughout the citrus-producing areas of Louisiana and Texas.

There is every reason to believe that continued systematic scouting in the citrus-producing areas of Texas and other States will ultimately result in complete eradication of citrus canker from the United States.

It will be noted that the figures in table 2 cover only the 6-month period beginning January 1, 1935. The few infected nurseries found in this work consisted chiefly of abandoned plantings, which were destroyed, and there were no indications that infected stock had been shipped from such nurseries.

TABLE 2.—*Citrus canker inspections, January 1 to June 30, 1935*

State	Counties or parishes inspected	Properties		Trees inspected			Trees	
		In-spected	Infected	Grove and dooryard	Abandoned	Nursery stock	Infected	De-destroyed
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Alabama.....	2	301	0	13,698	66,482	60,672	0	114,800
Louisiana.....	3	543	0	294,632	0	17,850	0	0
Mississippi.....	6	952	0	23,987	95,239	13,053	0	0
Texas.....	9	4,165	31	35,993	126,629	1,136,999	606	6,334
Total.....	20	5,961	31	368,310	288,350	1,228,574	606	121,134

## MEXICAN FRUIT FLY CONTROL

### ENLARGEMENT OF REGULATED AREA

On account of finding infested grapefruit near Falfurrias in March 1935, Brooks County, Tex., was added to the regulated area. The order putting this county under the regulations of Quarantine No. 64 was promulgated March 19.

One infested sour orange was also found at Premont, Jim Wells County, about 8 miles north of Falfurrias. In view of the fact that there is practically no fruit in this locality, Jim Wells County was not included in the regulated area.

### INFESTATIONS IN TEXAS

#### ADULTS

By the use of traps in groves and brush, adult *Anastrepha ludens* Loew were trapped during 7 months of the fiscal year 1935. The first fly was taken near San Benito on November 26. In December 11 more were taken in five districts, and in January 142 were submitted for identification from all districts of the regulated area except Mercedes and Raymondville. During February, March, April, and May the number of adults trapped was steadily reduced until June. In that month none was taken. The total for the year was 371 adults taken on 179 premises. The total includes 23 adults trapped in Starr, Webb, and Brooks Counties from 7 premises. The number of adult *A. ludens* taken in the valley proper represents an increase of 69 specimens over the previous year. There was, however, a decrease of 10 premises found infested for 1934-35. Adults were trapped at some time during the year in all districts except Raymondville.

Trapping outside the lower Rio Grande Valley revealed that several species of fruit flies were present in Brooks, Starr, Zapata, and Webb Counties. In these counties, 23 *A. ludens*; 1 *A. serpentina* Wied.; 6 *A. sp. Y*; 4 *A. fraterculus* of various authors, and 224 *A. pallens* Coq. were taken in traps. Although only Brooks County has been added to the regulated area, trapping operations were carried on in the other counties named in order to determine whether further enlargement of the regulated area might be necessary.

In the fall of 1933 a severe Gulf storm struck this area. This storm stripped immense quantities of fruit from the trees and in that year the high record for *A. ludens* trapped came in March. This past year the high record came in January and lacked one specimen of equaling the high of the previous March. There were 2 freezes in 1935, 1 on January 21 and the other on February 26. Doubtless these abnormal weather conditions affected the February catch considerably, as the total dropped from 142 for January to 42 for February.

On a basis of each 1,000 trap inspections made, there were 0.48 more *A. ludens* trapped from January through June in 1935 than in the corresponding period of the previous year.

The total number of adults of *Anastrepha ludens* trapped within this period is shown in table 3.



TABLE 3.—*Anastrepha ludens* trapped in Texas, fiscal year 1935

District	Adults	Premises	District	Adults	Premises
Mission.....	55	33	Harlingen.....	12	9
McAllen.....	32	19	San Benito.....	13	10
Edinburg.....	16	11	Brownsville.....	10	9
Pharr-San Juan-Alamo.....	97	29	Falfurrias.....	12	1
Donna.....	54	12	Starr and Webb Counties.....	11	6
Weslaco.....	31	21			
Mercedes.....	6	5	Total.....	371	179
La Feria.....	22	14			

## LARVAE

Infested fruit was found in six districts from Weslaco westward to Mission. The first larvae were discovered in February and the last were found during the clean-up in April. There were 30 premises involved in larval findings. This number includes 1 premise at Premont, Jim Wells County, and 2 premises near Falfurrias, Brooks County. The detailed larval findings are listed in table 4.

TABLE 4.—*Infestations of Anastrepha ludens* in Texas, fiscal year 1935

District	Larvae taken	Premises	District	Larvae taken	Premises
	Number	Number		Number	Number
Mission.....	269	10	Weslaco.....	41	4
McAllen.....	71	2	Falfurrias and Premont.....	42	13
Edinburg.....	7	2			
Pharr-San Juan-Alamo.....	300	6	Total.....	760	30
Donna.....	30	3			

<sup>1</sup> Infested fruit found in packing house at Falfurrias traced to 1 premise. This included in 3 infestations in Falfurrias and Premont district.

## OTHER FRUIT FLIES

By the use of traps the occurrence of nine other trypetids aside from *Anastrepha ludens* has been disclosed. Of these *A. pallens* occurs in largest number and is known to confine its attack to fruits of certain noneconomic native shrubs. A few specimens of the papaya fruit fly *Toxotrypana curvicauda* Gerst. have been captured, but the species has no economic significance under valley conditions. The other 7 species have not been found infesting fruit and comparatively little is known of their habits; 4 of them represent undescribed species. Of the better known species, *A. serpentina* was taken 96 times in traps rather generally over the entire area; 179 specimens of *A. fraterculus* were taken, also generally distributed; and 4 adults of *A. striata* were taken from Edinburg, Mission, and McAllen districts.

## COLLECTIONS OF SPECIMENS

During the year 30,790 specimens were submitted to the Harlingen, Tex., laboratory for identification. This total includes all the specimens sent in by inspectors, both in Texas and Mexico, but does not include many larvae collected in Matamoros and turned over to the Mexican inspector for rearing purposes and transmittal to Mexico City.

## GENERAL INSPECTIONS

Part of the general duties of the inspection force is grove inspection for infested fruit and unsanitary conditions in the groves; tree-to-tree inspection on final clean-up; trap operations, and removal of alternate host-fruit trees and fruit. This work is carried on throughout the year. During the past year 37,907 grove inspections were made. Traps were examined 331,635 times on 3,474 premises, and 104 alternate host-fruit trees were destroyed on 35 properties with the consent of the owners.

## INSPECTIONS IN MEXICO

Since the inception of this project, it has been deemed advisable to keep an inspector at Matamoros for the purpose of trapping, spraying, and collecting infested fruit. There has recently been added one part-time inspector at Reynosa. It is believed that much of the danger of reinfestation from Mexico is reduced by collecting infested fruit before it is sold and before the larvae are widely scattered along the border.

These inspectors trapped in these two border cities and adjacent wild growth, 68 *Anastrepha ludens*, 1 *A. fraterculus*, 7 *A. sp. Y*, 2 *A. striata* Schin., 14 *A. pallens*, 1 *A. serpentina*, and 1 *Anastrepha* sp., probably new. They also collected from market fruit 21,637 *A. ludens* larvae, 135 *A. striata*, 57 *A. serpentina*, 73 *A. fraterculus*, 1,028 *Anastrepha* sp. probably *A. acidusa* Walk., and 179 *Rhagoletis* sp. The total of all specimens submitted was 23,109.

It is granted that all infested fruit on the markets is not found but, by intensive trapping and spraying where adults are found, no larval infestations have been located during the past year in locally grown fruit.

Table 5 gives in detail the results of inspection in Matamoros, Reynosa, and adjacent wild growth.

TABLE 5.—*Infestations of Anastrepha spp. and other Trypetidae in Mexican border cities and adjacent wild growth, fiscal year 1935*

Month	Adults trapped							Larvae and pupae found in market fruit					
	<i>A. ludens</i>	<i>A. fraterculus</i>	<i>A. sp. Y</i>	<i>A. striata</i>	<i>A. sp. probably new species</i>	<i>A. pallens</i>	<i>A. serpentina</i>	<i>A. ludens</i>	<i>A. sp. not ludens</i>	<i>A. striata</i>	<i>A. serpentina</i>	<i>A. fraterculus</i>	<i>Rhagoletis</i> sp.
							Total						Total
July.....	18						18	11,340			27	42	11,409
August.....	9						9	73		12	27	1	113
September.....	4				1		5	47		12	18	1	80
October.....							0	84		13		2	165
November.....	6			1			7	1,091		9		1	1,211
December.....	6						6	88		14			102
January.....	11	1		1			13	307		86			393
February.....						3	3	3,047		1			3,048
March.....			4			9	13	3,504					3,504
April.....	3		2				5	682	3				685
May.....	6		1			2	9	1,037	77				1,114
June.....	5						6	337	948				1,285
Total.....	68	1	7	2	1	14	94	21,637	1,028	135	57	73	23,109

## SPRAYING OPERATIONS IN TEXAS

When an adult *A. ludens* was trapped or larvae were found, the grove in question was sprayed with a nicotine sulphate-molasses spray. During the past year, from December through April, the trees on 232 premises were given at least one complete coverage with this spray and in some instances certain groves were sprayed twice. There were 92,613 trees sprayed.

Table 6 embodies this complete record for the year, with comparative figures for 1933-34.

TABLE 6.—*Summary of spraying operations in Texas, fiscal year 1935*

Month	Trees sprayed	Premises sprayed	Material used	
			Nicotine	Molasses
	Number	Number	Gallons	Gallons
December.....	2,071	5	11	220
January.....	14,274	31	66.75	1,335
February.....	8,255	23	27.50	550
March.....	33,270	98	100.4	2,000.5
April.....	24,743	75	107.84	2,157.5
Total.....	82,613	232	313.49	6,263
Total for 1933-34.....	95,657	243	419	8,581



## SHIPMENT OF FRUIT

The shipping season of 1934-35 opened on September 26 and the harvesting season closed April 2. The last fruit to leave the valley was permitted out in May. This was from cold-storage plants. Railroad reports for the season show 4,572 solid carloads of fruit and 38 carloads of mixed fruit and vegetables leaving the valley. These rail shipments show on our records as 4,679 equivalent car lots. The base used in computing equivalent car lots was 372 boxes, 575 bushels, or 30,600 pounds in sacks. The increase in equivalent car lots over actual carloads was due in large part to the fact that fruit shipments in sacks averaged considerably higher than 30,600 pounds to the carload. A total of 17,699 permits for shipment of fruit by truck were issued during the season, or 2,801 equivalent car lots. Shipments by express are estimated at 100 equivalent car lots. This makes a grand total for the season of 7,571 equivalent car lots.

During the shipping season of 1934-35 the new 100-pound box was introduced to the trade, 5 carloads of fruit being packed in such containers. A new bushel box was also used to a small extent. The 10-pound sack was popular during the holiday period, 15,644 of such containers being used. The use of sacks for containers increased greatly during the season, 15 percent of the crop being moved in such containers, as compared to 0.5 percent the previous season. Of the total fruit shipped, oranges constituted 17 percent.

## ROAD TRAFFIC INSPECTION

In order to enforce quarantine regulations, it is essential that motor vehicles be inspected when leaving the area. A road station is located on the main highway at the Brooks County line and this station passed 11,631 trucks from November to March, inclusive. These trucks carried 2,283.6 equivalent car lots of fruit. The average trucker is well aware of the regulations and, as a result, only 9 trucks were turned back on account of not having correct permits. Details of road-traffic inspection will be found in table 7; however, as the road station was open only from November through March, not all details of fruit movement by motor vehicles for the entire season are shown in this table.

TABLE 7.—Road-traffic inspection, fiscal year 1935

Month	Trucks inspected		Fruit passed, packed in boxes and baskets					
	Passed	Not passed	Grapefruit		Oranges		Total	
	Number	Number	Boxes	Bushels	Boxes	Bushels	Boxes	Bushels
November.....	1,534	1	19,731	63,111	7,678	62,153	27,409	125,264
December.....	2,569	6	20,781	93,484	7,711	130,616	28,492	224,100
January.....	2,676	0	21,550	116,955	5,736	122,348	27,286	239,303
February.....	2,851	1	18,204	140,218	8,868	122,613	27,072	262,831
March.....	1,991	1	26,481	130,149	1,627	35,509	28,108	165,658
Total.....	11,621	9	106,747	543,917	31,620	473,239	138,367	1,017,156

Month	Fruit passed in sacks				Fruit confis- cated
	Grape- fruit	Oranges	Total		
	<i>Number</i>	<i>Number</i>	<i>Sacks</i>	<i>Pounds</i>	<i>Packages</i>
November.....	<sup>1</sup> 1,360	<sup>1</sup> 1,361	2,721	137,875	42
December.....	<sup>1</sup> 4,667	<sup>1</sup> 5,000	9,667	655,340	42
January.....	11,471	3,479	14,950	1,192,360	18
February.....	23,252	4,937	28,189	2,255,120	0
March.....	14,858	424	15,282	122,670	0
Total.....	55,608	15,201	70,809	4,363,365	102

<sup>1</sup> The total amount of fruit in sacks passed is correct. The kind of fruit in sacks was estimated for November and December.

## MISCELLANEOUS

## CANNING PLANTS

Eleven citrus-canning plants were in operation during part of the shipping season of 1934-35. These plants used 16,292 tons of grapefruit, most of it being juiced. This tonnage roughly equals 1,085 cars.

## EXPERIMENTAL SPRAYING

This project carried on spraying experiments this season in cooperation with the Bureau of Chemistry and Soils and the Bureau of Plant Industry. The purpose of these experiments was to determine what effect, if any, tartar emetic had on citrus trees and fruit. It is planned to continue these experiments through the coming season.

## WILD-HOST STUDIES

As several species of fruit flies are frequently taken in traps in the valley, it is thought that these flies are breeding in various local hosts. A study of the flora of the valley is, therefore, being made and collections of fruits and plants are sent in to the laboratory daily. Examination in the field is also being made. With the exception of one collection of *Anastrepha* sp. larvae, reported as coming from the fruits of cactus, these studies have all given negative results.

## WEST INDIAN FRUIT FLY AT KEY WEST, FLA.

Cooperation has been continued with the State Plant Board of Florida in its effort to eradicate two forms of the West Indian fruit fly from the island of Key West. As an aid in carrying on this work, an allotment of \$36,000 was made available by the Public Works Administration, and the spraying, trapping, inspection, and fruit-removal work was materially increased. Some 2,000 traps were used to detect the possible presence of the adult flies, thus greatly intensifying the inspection. Fewer adults were collected than during the past year, and no immature stages of either *Anastrepha acidusa* Walker or *A. suspensa* Loew were found during the 10 months ended June 30, indicating that definite progress has been made in reducing the numbers of these insects.

## DATE SCALE ERADICATION

Inspection was continued over a smaller area during the year, a considerable acreage having been dropped as free from scale during the fiscal year 1934. Further reduction in acreage was made in the eradication area during the present fiscal year. Clean-up work was completed in Arizona. No *Parlatoria* scale was found during the year.

## COACHELLA VALLEY

During the year, 6,167 palm inspections were made from ground and ladders; 25,750 were made from the ground only; and 6,967 offshoots were certified for movement. Leaf bases were removed from 29 previously infested palms; 6 previously infested palms and 4 adjacent ones were dug out and destroyed; and 2,343 palms in or near previously infested plantings were pruned to facilitate inspection. No *Parlatoria* scale has been found in the Coachella Valley since November 1931.

## IMPERIAL VALLEY

In the Imperial Valley 4,478 palm inspections from ground and ladders and 14,545 from the ground only were made, and 356 offshoots were certified for movement. Leaf bases were removed from 24 previously infested palms; 2 valueless palms were dug out and destroyed and 77 were pruned to facilitate inspection. No infested palm was found during the year, as compared with 11 found on 1 property during the fiscal year 1934, and 7 on 4 properties in 1933.

## PHOENIX DISTRICT

In the Salt River Valley of Arizona and other localities in Arizona 12 palms were inspected from ground and ladders and 2,617 from the ground only. Four



sections were scouted for unlisted palms and 307 properties checked for volunteers. This concludes the eradication work in the Phoenix district, except for the final inspection of a few plantings of offshoots from previously infested properties in the Coachella Valley and the Imperial Valley.

#### YUMA DISTRICT

In the Yuma district 530 palms were inspected from ground and ladders and 16,173 from the ground only, and 139 offshoots were certified for movement. Leaf bases were removed from 97 previously infested palms, 643 palms in the infested area were dug out and destroyed, 239 palms were pruned and offshoots destroyed, and 14 were pruned. No scale was found. This concludes the eradication work in the Yuma district, except for ladder inspection on 3 properties.

A summary of date scale activities is given in table 8.

TABLE 8.—*Summary of date-scale activities, fiscal year 1935*

Item	Arizona		California		Total
	Yuma district	Phoenix district	Coachella Valley district	Imperial Valley district	
Palms inspected from ground and ladders.....	530	12	6,167	4,478	11,187
Palms inspected from ground only.....	16,173	2,617	25,750	14,545	59,085
Offshoots inspected for movement.....	139	0	6,967	356	7,462
Palms pruned to facilitate inspection.....	14	0	2,343	77	2,434
Palms pruned and offshoots destroyed.....	239	0	0	0	239
Palms leaf-base inspected.....	97	0	29	24	150
Palms dug out and destroyed.....	643	0	10	2	655
Sections scouted for unlisted palms.....	0	4	0	0	4
Properties checked for volunteers.....	0	307	0	0	307
Palms checked to determine clean-up necessary.....	4,934	0	0	0	4,934

## JAPANESE AND ASIATIC BEETLE INVESTIGATIONS

### JAPANESE BEETLE

The area continuously infested by the Japanese beetle in 1934 was estimated at 9,700 square miles, in the States of New Jersey, New York, Pennsylvania, Delaware, and Maryland. This is an increase of 900 square miles over 1933. No appreciable increase in the beetle population was found in the older infested area of New Jersey. The infestation has definitely increased in the more recently infested counties in southern New Jersey and in nearly all of the infested sections of Pennsylvania, Delaware, and Maryland. A source of public complaint has been the number of beetles, dead and alive, washed up on the shores of bathing beaches. A combination of favorable winds and high temperatures at the time of maximum beetle flights resulted in enormous swarms of beetles being carried over the Delaware River and the Atlantic Ocean. This situation has been particularly annoying along the New Jersey and Long Island coast beaches.

It has been found that larval populations develop faster in sod fields than in cultivated fields. The average density of the larval population in the heavily infested districts ranged from 13.7 in pastures to 2.3 per square foot in pumpkin fields. It is evident that the population is higher in fields planted to crops, such as corn and asparagus, on which beetles feed readily, than in fields of tomatoes, potatoes, and pumpkins, which are only occasionally attacked.

During the past two winters unusually low temperatures and heavy snows occurred in the area of general infestation. Owing to the presence of a heavy covering of snow, the soil temperature was only slightly influenced by the cold, and there is no evidence that there was any marked general reduction of the larval population.

Bacterial diseases, particularly the "milky" disease which appears to develop at a temperature above 60° F., caused a noticeable reduction in the larval population during the spring of 1935; in limited areas in some localities about one-fifth of the larvae were affected. The occurrence of disease is, however, localized and subject to considerable fluctuation due to variable soil conditions.

Comparative tests were conducted under controlled conditions with many materials as substitutes for lead arsenate in soil for the control of the larvae. Some of these materials were equally as effective in destroying the insect but are either costly or injurious to plants. It was found that the effectiveness of acid lead arsenate in killing the larvae is modified by the type of soil. This difference was not correlated with the total salts present or the pH of the soil. The amounts of soluble ammonia, phosphorus, and magnesium were the most important factors influencing the insecticidal action under favorable conditions, the effectiveness being increased in soils containing high concentrations of water-soluble ammonia or phosphates and decreased with the increase of soluble magnesium salts in the soil.

The adult beetle causes considerable damage to roses in commercial greenhouses by emerging during the winter months and feeding on blooms. Tests during the season indicate that this damage can be prevented without injury to the plants by treating the beds with lead arsenate. Preliminary data indicate that ortho-chloro-phenol, cresol, limpid oil, and carbasota may be of considerable value as repellents for the Japanese beetle and thus afford protection to flowering shrubs in home gardens against injury by the beetle.

In further study of the geraniol bait as an attractant for the Japanese beetle, it was found that none of the constituents of geraniol is more than 60 percent as attractive as the recommended combination of geraniol and eugenol. Phenyl ethyl alcohol added to the standard bait increased the attraction, but the increase in the cost of the bait for a comparatively small gain in the number of beetles caught does not appear to be warranted under general conditions. These studies have made it possible to prepare and recommend specifications for a cheaper grade of geraniol for use in attracting the Japanese beetle. It has been definitely established that traps painted green and white are superior to traps painted with other colors. Public-service patents covering two types of Japanese beetle traps have been granted to F. W. Metzger.

Derris is a weak stomach poison but has a definite repellency for the adult Japanese beetle, the repellent action appearing to be due to the rotenone and deguelin content. Exposure to light decreased the effectiveness of derris and the material was readily washed from foliage by rain. Several materials have been tested as stickers and as means to prevent the decomposition of derris in the field. Oils, while very effective stickers, have been found to accelerate the decomposition of derris when spread in a thin layer on the surface of the leaf. The emulsified residue from rosin stills has been found to be the cheapest and most effective sticker that does not accelerate the decomposition. The addition of magnesium silicate to the spray increased the period that the material is effective as a repellent. Derris without a sticker appeared to be of little value in the protection of early ripening apples from attack by the beetle. Derris with the sticker has given promising results. The derris spray has a disadvantage in that it is necessary to repeat the application every week to maintain good control.

It has been known for several years that the application of hydrated lime afforded considerable protection to foliage from injury by the beetle, but the material was limited in its usefulness on account of its poor adhesiveness. The addition of aluminum sulphate to the lime spray produced a residue on the foliage which lasted through the summer. The use of this cheap, nontoxic repellent spray offers considerable promise in commercial orchards and on ornamental trees and shrubs.

Investigation to develop methods for treating agricultural commodities to prevent artificial dispersion of the insect by human agencies suggests that fumigation with hydrocyanic acid, carbon disulphide, or ethylene oxide, now used for the treatment of small fruits and bananas, might be extended to include potatoes, onions, cabbage, peaches, apples, and certain other farm products. The lead arsenate treatment of nursery stock in the field has been very satisfactory and has made it possible to eliminate grubs in the soil about the roots of large quantities of stock. The major weakness of the treatment is in the lack of a uniform distribution in the commercial nurseries. In tests, uniform distribution was obtained by applying lead arsenate over the whole area of ground on which plants were standing and working it into the soil. The application of the lead arsenate only to the area between rows of plants did not, however, result in a uniform distribution. Encouraging results have been obtained with paradichlorobenzene for the treatment of certain varieties of azaleas and potted plants to destroy larvae in the pots.



Considerable progress has been made in the colonization of imported parasites of the Japanese beetle at a number of points in the generally infested area. *Tiphia vernalis* Roh. is now well established and increasing rapidly. In the spring of 1935, 141 colonies were placed in heavily infested areas in New Jersey, Pennsylvania, and Delaware, making a total of 493 colonies of this species in the field. *T. popillivora* Roh. was definitely established in 1926 and has been extensively colonized; 185 colonies were placed in the field during this summer, bringing the total number of colonies to 379. This species shows more fluctuation in population from year to year than *T. vernalis*. Two colonies of the Korean strain of *T. popillivora*, which appears in the field later than the Japanese type and is more nearly synchronized with the appearance of the third-instar larvae, were placed in the field, and sufficient material is available to place approximately 20 colonies of this parasite in the field during the coming year.

#### THE ASIATIC BEETLES

The Asiatic garden beetle (*Autoserica castanea* Arrow) has continued to spread westward on Long Island and in Westchester County, N. Y., in suburban areas immediately adjacent to Philadelphia, Pa., and throughout New Jersey. The injury caused by the grubs to vegetable seedlings was marked late in the spring and early in the summer. A large number of complaints were received from restaurants, drug stores, and baseball parks and other places of amusement which operate at night and use large flood lights, because the beetles were attracted to the lights in such enormous numbers that they became a nuisance and curtailed business activities.

It has been found that rose geranium oil, eugenol, and tansy oil are definitely attractive to this beetle, indicating the possibilities of using these materials to increase the capture of the beetles in the light traps. Two types of traps and lights were tested, and on favorable nights as many as 2,000 beetles per trap were captured in a single hour. Tests during the summer indicate that this beetle can be controlled in vegetable gardens by the use of a poisoned bait containing bran, lead arsenate, molasses, and water.

*Tiphia asericæ* A. and J., a Chosenese parasite of the Asiatic garden beetle, which was liberated in previous years in the vicinity of Philadelphia, in northern New Jersey, and on Long Island, has been recovered in these localities.

The status of the oriental beetle (*Anomala orientalis* Waterh.) is about the same as in 1934, the spread of this species being relatively slight. Some injury has been observed in lawns and gardens but much less than is caused by the Asiatic garden beetle.

### JAPANESE BEETLE QUARANTINE AND CONTROL

#### EXTENT OF INFESTATION

For the first year since the original quarantine on account of the Japanese beetle was issued in 1919 it was not considered necessary to extend the territory under regulation. Only three first-record finds of major importance—at St. Louis, Mo., Chicago, Ill., and Indianapolis, Ind.—were recorded during the 1934 trapping season. The most outstanding find at a point remote from the central infested area was that disclosed at St. Louis, where beetles were collected in such numbers as to indicate an established infestation. At Indianapolis 17 beetles were caught in a residential section at some distance from a railroad line. This infestation probably resulted from illegal transportation of infested plant material. The locations at which were trapped 6 beetles in Chicago and 1 beetle in East St. Louis, Ill., point to the probability that these adults had been transported by rail from the heavily infested sections of New Jersey or Pennsylvania.

With limited funds available for determining the spread of the insect, trapping was confined to those States immediately adjacent to known infested territory. Supplementing trap surveys in nonregulated territory in Maine, New York, Pennsylvania, Ohio, West Virginia, Virginia, and Maryland, traps were operated to check previously determined infestations in Detroit, Mich., St. Louis, Mo., and Greenville, S. C., and to determine presence of the insect in Chicago and East St. Louis, Ill., and a few selected cities in Indiana. The season's trapping program began in Virginia on June 18. Trap distribution progressed northward following the dates of probable beetle emergence. The latest traps set were those placed in Maine. Except in cities where continued

catches were being made, most of the traps were lifted after a 30-day period of operation. Final lifting of the late-operated traps in Maine was accomplished by September 21. Prior to use, these traps were reconditioned and coated with aluminum paint. As this protective coating weathered much better than the previously used combination of green and white enamel, the traps, after being lifted for the season, were stored in municipally owned and county-owned buildings, from which they may be readily distributed to adjacent territory next season. Curtailment of funds allowed the operation of only 31,000 of the project's supply of 56,000 traps.

In addition to the important first-record finds disclosed, beetles were caught in 5 cities in Maine; 58 Maryland communities both inside and outside the regulated zone; in Detroit, Mich., where a few beetles have been trapped each year since 1932; in 9 New York cities; in 6 Ohio localities; in Erie, Pa., where an infestation first was disclosed in 1931; in 6 cities in Virginia; and at 7 points in West Virginia. Traps set in Greenville, S. C., in an effort to pick up additional beetles at the site where two beetles were collected by hand, failed to catch any further specimens. Practically all of the few first-record infestations found in these States consisted of a few beetles each. None of these findings clearly pointed to an established infestation.

The setting of traps in St. Louis for the 1935 season began on May 10 from a supply of 10,463 new standard traps shipped directly to St. Louis from the manufacturer in Philadelphia. By the end of the fiscal year, 5,915 of these were in operation, and a total of 38 beetles had been caught. Owing possibly to later emergence, this was a considerable reduction over the 1934 figures on the same date. At that time only 820 traps had been in place for a period of 11 days or less, and 513 beetles had been captured. The fall application of lead arsenate to the infested sections, although less effective than it would have been had the ground been poisoned before the eggs hatched, may have aided in preventing any great increase in the larval population.

Southern trapping was under way at the end of the fiscal year in North Carolina, South Carolina, and Virginia, the only Southern States in which traps were used in 1935. Traps were used in 33 localities in North Carolina, 23 in South Carolina, and 33 in Virginia. Trap tenders in these States were supplied from relief rolls under projects approved at the request of the State entomologists of the respective States. A few beetles each had been trapped at Charlotte, Durham, Elizabeth City, Goldsboro, Greensboro, Lumberton, Raleigh, Rocky Mount, Salisbury, Sanford, and Statesville, N. C., and Ashland, Culpeper, Emporia, Hopewell, Petersburg, Sandton, Westhampton, Dunreath, and Westover Hills, Va. Trap captures in larger numbers had been made in Spencer and Winston-Salem, N. C., and Greenville, S. C., where catches had been made in previous seasons. Most of the traps used in these Southern States were drawn from a supply of 20,000 collapsible tin-plate traps die stamped and assembled at the New Cumberland, Pa., warehouse.

Peak emergence of the adult beetle during 1934 was from 10 days to 2 weeks in advance of the usual date for maximum emergence. By July 4, in densely infested sections of southern New Jersey, beetles had balled on early apples, and browning of foliage on badly devoured trees was plainly evident from a distance. By July 10 the foliage of many trees was completely skeletonized in the Shiloh section. Beetle activity reached its peak by the middle of July. Beetles were present in greater numbers than ever in Wilmington, Del. Cut flowers presented for inspection at the wholesale houses in Philadelphia showed evidences of beetle feeding. Frequently consignments of spirea from New Jersey were badly eaten by the insect.

Although the Bureau made no attempt to survey the damage caused by the insect during the summer of 1934, a rather comprehensive survey of Japanese beetle damage was made during the year in Cumberland County, N. J., under the auspices of the Emergency Relief Administration of the State. Investigators working on the survey canvassed 4,047 individuals (farmers and also property owners in towns and cities) representatively scattered throughout the county. Definite reports of beetle depredations were received from 2,570 of those interviewed, and 761 individuals stated their losses in terms of crop percentages. Only 715 reported no injury. Total damage of \$166,646 on 42,004 acres was reported in the 2,570 definite returns. This involved an average damage of \$3.97 per acre. This sum was also used in arriving at a total damage of \$102,017 on the 25,697 acres covered by the 761 reports expressed in crop percentages. The 716 individuals reporting freedom from injury operated an additional 9,910 acres. In total, the survey disclosed an estimated loss



of \$268,663 on 77,611 acres, or an average per acre damage of \$3.46. There are in Cumberland County 330,080 acres, 51,087 of which are in marsh land. As the county is primarily agricultural, there are in it approximately 278,993 tillable acres. Figured at the average damage per acre, county-wide damage of \$965,316 is estimated. Irrespective of possible factors that might reduce this estimate, it is apparent that Japanese beetle damage is an important factor in the cost of producing farm commodities in this southern New Jersey county. From an analysis of the collected data, it is the conclusion of the Cumberland County planning engineer that concentration of the infestation in the vicinity of Shiloh is due chiefly to the inability of the beetles to cross Delaware Bay, thus resulting in a piling up of the insect in that section. A similar survey was made as an Emergency Relief Administration project in the adjoining county of Gloucester, but data collected were not made available to the Bureau.

In heavily infested agricultural sections in southern New Jersey, sections that for years have been subject to intensive beetle damage are still holding their maximum populations. For 3 consecutive years early maturing apples in certain orchards have been rendered unsalable by beetle feeding. In the Philadelphia water-front district the heavy flight of the adult expected in 1933 did not occur. In the summer of 1934 the insect resumed its heavy flight in the wharf and market districts, contradicting previous indications that the population might have decreased permanently. The adult flight in Philadelphia lasted for nearly 5 weeks, from July 11 to August 13.

Beetle feeding in one block of 1,200 Yellow Transparent apples located in southern New Jersey was responsible for almost complete destruction of the crop. In 1933, 3,600 bushels were harvested from the orchard. Only 36 bushels could be picked in 1934. Other severe commercial damage was evident throughout the densely infested sections.

Flotations of adult beetles in Delaware Bay, Raritan Bay, and the Atlantic Ocean were again observed, but not to the same extent as in 1933. The flotation from New Jersey to the Delaware shore on Delaware Bay was most pronounced in mid-July. Beetles were washed up on the beaches of Long Island on August 10.

Although Waterville, Maine, was included within the regulated zone as an extension of territory resulting from the spread determined in 1933, trapping was repeated there again in 1934 to learn whether the record-breaking subzero weather between the two seasons had killed off the overwintering grub population. Instead of 204 traps being operated for 30 days, as in 1933, this year 300 traps were set for 40 days; and, whereas last year 139 beetles were trapped, this year's capture increased to 299. Apparently the soil temperature at a depth of 6 inches or more did not decline sufficiently to affect larval survival.

#### SUPPRESSIVE MEASURES

Another progressive reduction in the number of beetles captured in Erie, Pa., was recorded as a result of trapping in that city. A total of 1,427 traps was in operation from July 6 to September 8. This was the largest concentration of traps ever set in the city. Successive years' captures in Erie have been: 1931, 171; 1932, 282; 1933, 167; and 1934, 114. Of the 1934 total, 43 specimens were survivors of infestations discovered in 1933 and first treated in the fall of that year. Most of the remainder represents spread not previously determined. The significant feature of the control work in Erie is that intensive trapping in the older infested section of over 44 acres, where the soil has been poisoned for a period of 2 or more years, disclosed only 3 beetles emerging from the entire area. Continuing the intensive eradication measures of previous years in Erie, the sections surrounding infestations found during 1934 in unpoisoned areas were treated with lead arsenate at the rate of 1,000 pounds per acre. This treatment, involving the application of the soil insecticide to 6.6 acres, was accomplished between September 10 and 17, immediately following lifting of the traps for the season.

Approximately 2,600 traps were set from June 19 to August 25, 1934, in the sections of St. Louis, Mo., believed most likely to be infested, with the resulting capture of 1,351 beetles. Funds were made available by Executive order that enabled the Bureau to apply lead arsenate to all sections of the city where beetles had been caught. Work was begun on September 26 and concluded on November 3. In all, 220 tons of lead arsenate were applied to 440 acres comprising the soil area in 117 infested city blocks. This is the largest control program ever

undertaken at an isolated infestation. Laborers to assist in applying the poison spray were supplied by the local relief administration. The city fire department loaned hose lines. State and city officials accorded excellent cooperation in facilitating the work. Results of scouting of nurseries and greenhouses within a 10-mile radius of St. Louis were negative. A State quarantine on the movement of host material from infested sections is now enforced.

As soon as applications of lead arsenate were completed in St. Louis, the spray equipment was transferred to Indianapolis, Ind., where 38.6 acres were treated at the rate of 1,000 pounds of the soil insecticide per acre. These operations extended from November 7 to 17.

Five tons of lead arsenate were applied between December 3 and 7 to the premises in Charlottesville, Va., on which 60 Japanese beetles were trapped during the summer of 1934. The treated sections comprise 10 acres in a residential section near the Chesapeake & Ohio Railroad freight yards and the Pullman cleaning yards. Arrangements were made by the city manager of Charlottesville for relief labor and the use of necessary city equipment to augment two Federally owned spray outfits.

Trapping by the park department of the city of Springfield, Mass., resulted in the capture of 45,000 beetles. In 1933, 36,000 beetles were caught in the same area. One encouraging feature of the control work is that very few beetles were caught in traps placed in the sections which several years ago received lead arsenate treatments. In West Springfield, where some 5,000 beetles were trapped in 1933, the traps collected only approximately 2,000 beetles. As was the case in Springfield, practically no beetles were caught in traps operated in blocks previously poisoned.

#### HIGHWAY INSPECTION SERVICE

Vehicular-inspection stations at the border of the regulated territory were already in operation on July 1 at 20 locations. Seven posts were located on the southern border of the Virginia regulated section, two on the Maryland-West Virginia State line, one in West Virginia, seven on the Pennsylvania-West Virginia and Pennsylvania-Ohio State lines, and three in Pennsylvania to cover the highways leading from the regulated area of that State. In addition, three inspectors furnished with cars alternated between seven less important highway stations in the latter State. The highway inspection force numbered 32 men. Closing of these road stations began on October 9. All stations on the border of or within Pennsylvania were discontinued by November 2. The single station maintained near Keyser, W. Va., was closed on October 15. Five of the nine stations inspecting southbound traffic were closed just prior to or shortly after Armistice Day. Continued southern movement of holiday plant material justified operation until November 10 of the stations on United States Highways Nos. 1 and 17 south of Fredericksburg, Va. Posts on United States Routes Nos. 50 and 211, west of Fairfax, Va., continued to inspect southbound traffic until December 22 and 23, respectively. The final interception of infested contraband during 1934 was made on November 1.

Late in March 1935 the four Virginia stations that were last to close in 1934 were reopened. Resumption of activities at 14 other established posts in Virginia and on the State lines northward quickly followed, with the northernmost Pennsylvania-Ohio State line post opening on April 19. These included a new Virginia post on State route no. 7. Guarding of the roads leading intrastate from the Pennsylvania regulated territory began on April 29. Pennsylvania inspectors were assigned by May 10 to the last of 11 stations to be operated during the season. An additional post was involved in the 1935 Pennsylvania intrastate set-up. Engaged in this work at the end of the fiscal year were 29 Federal and 4 Pennsylvania inspectors.

Interceptions were made at the road posts of 98 lots of plant material or other products containing Japanese beetle infestation. From these contraband products there were removed 184 larvae and 76 adults. This is a considerable increase over the preceding year, when 112 larvae of the insect were collected. The largest number of interceptions of infested material was made at the inspection station located just south of Fredericksburg, Va., on United States Route No. 1. Other stations at which numerous lots of infested products were caught were located on United States Routes Nos. 50 and 211, west of Fairfax, Va., and on United States Highway No. 40, west of West Alexander, Pa. Many important interceptions were made. Among them 16 Japanese beetle larvae were removed from 50 potted plants en route from Wawa, Pa., to Lower



Salem, Ohio. Examination of soil accompanying a single flowering plant being moved from Philadelphia, Pa., to Inkster, Mich., resulted in collection of 12 larvae. From numerous larvae taken from soil about the roots of 2 zinnias, 9 pansy plants, and 1 ivy plant being transported from Westtown, Pa., to Chautauqua, N. Y., there were identified 9 Japanese beetle grubs. Nine larvae were taken from soil about the roots of two evergreens found in the possession of a motorist traveling from Woodstown, N. J., to Carmel, Ind. One of the summer interceptions consisted of nine adults taken from the cab of a truck en route from Lime Rock, Pa., to Woodstock, Va. All suspected larvae intercepted by road patrolmen are forwarded to field headquarters for identification.

Among nursery stock surrendered at the road stations were 130 lots of five-leaved pines seized while being transported in violation of Quarantine No. 63.

Inspection of small lots of plants and farm products by road inspectors was continued. The practice of removing uncertified soil and replacing it with fumigated soil on hand at the posts has met with very favorable public response and has materially reduced the frequent complaints that formerly were received from drivers who were obliged to surrender their products or return to a designated center for inspection and certification.

Motor vehicles stopped for inspection at the road stations during the year numbered 2,455,072. Of the cars and trucks examined, 16,695 were found to be transporting uninspected quarantined products.

#### CERTIFICATION AND TREATMENT OF NURSERY STOCK

Nursery and greenhouse scouting in the summer of 1934 resulted in the finding of adult beetles on a larger number of theretofore uninfested premises than were determined as infested in 1933. Infestations were found for the first time on 64 classified establishments, as compared with first-record finds on 33 such premises the preceding summer. Beetles have been found on the premises of 80 percent of the 363 classified establishments in New Jersey. This condition is largely a result of natural spread of the insect. Among 2,241 nurseries and greenhouses fulfilling the quarantine requirements for classification, 555 are infested and the owners are obliged to grow their stock in screened greenhouses, free it from soil, or chemically treat it before shipping to noninfested territory. This is a net decrease of 135 in the number of establishments on the classified list. There was a large reduction in infested classified establishments, many of which relinquished their classified status rather than conform to the conditions necessary for keeping their stock free from beetle infestation.

Spring demands for inspection and certification of nursery stock were consistently heavy in all States under regulation. A number of shippers that had been inactive for the past 3 years suddenly began shipping, with a consequent need for detailed examination of plant material from an unexpected source. This required that additional inspectors be hired to supplement the regular inspection force.

Soil samples collected from nursery plots treated with lead arsenate were submitted to the Japanese beetle research laboratory for analyses. For the purpose of determining the present toxicity of poisoned nursery plots, 873 samples were collected during April and the early part of May. Results of the analyses were available in time to permit nurseries to restore their treated sections to the required dosage of 1,500 pounds of the soil insecticide per acre by the dates prescribed in the treating instructions. A total of 76.7 acres, containing 362,048 items of growing nursery stock, is involved in the poisoned areas treated during the year. This acreage includes plots newly treated, those re-treated and brought back to their original dosage, and plots found upon analyses to have carried over a sufficient concentration of the lead arsenate. Seventeen tons of powdered lead arsenate were distributed on nursery plots by the owners in completing initial treatments and re-treatments. Some 1,200 pounds of this amount was applied to 94,463 square feet of heeling-in areas and coldframes.

Cooperative experiments with the Japanese beetle research laboratory resulted in the adoption of a treatment whereby certain species of azalea may be rid of Japanese beetle infestation by means of paradichlorobenzene fumigation. Interested nurseries furnished plants used in the tests, and were very anxious to have such a method approved. This new method permits certification of types of plants that are not tolerant to the commonly employed chemical

treatments. Growers previously have been obliged to raise them for certification in screened greenhouses or in beetle-proof outdoor enclosures. Simplification of azalea treatments offers a valued outlet for these plants to many growers who heretofore have considered the conditions of certification too rigid for compliance. Similar tests are being made with blueberry, holly, *Franklinia*, and rhododendron plants.

Supplemental distributions were made of the Japanese Beetle Quarantine Shipper's Guide, although no new edition of the guide was necessary, as the territory under regulation remained unchanged.

As a new departure in the service rendered to classified establishments, there was distributed to all such dealers a list showing the nurseries and greenhouses complying with the classification requirements. Monthly supplements mailed to the dealers keep this information current. As classified dealers whose premises are infested are required to report all their shipments of quarantined material to other classified establishments within the regulated areas, this list was supplied to avoid any noncompliance with this requirement due to lack of information as to those maintaining a classified status.

#### CERTIFICATION OF FRUITS, VEGETABLES, AND CUT FLOWERS

Heavy flights of the beetle during the summer of 1934 at a number of spur tracks in New Jersey at which large quantities of agricultural products are loaded in refrigerator cars made it necessary to intensify the methods used to prevent such cars from becoming infested. As soon as the cars were spotted for icing and loading, an inspector examined the ice bunkers and interior of the car for live beetles. Upon completion of the inspection and removal of any beetles present, the hatches of the ice bunkers and the doors of the car were closed and sealed until loading or icing began. If beetles were flying, the loading was delayed until the flight had subsided for the day. At Cedarville, N. J., a special beetle-proof canopy sufficiently large to cover an entire truck was constructed. This canopy was moved up to the door of a refrigerator car and the intervening space between the car and canopy screened with loose mosquito netting. The truck load of certified products was then backed into the cage and a canvas curtain lowered over the open end of the canopy. Any beetles present in the cage were killed with a contact insecticide applied from a hand sprayer. The doors of the car were then opened and the unloading proceeded. When one truck had unloaded, the doors of the car were closed until the next load backed in, when the procedure was repeated until the car was completely loaded. Pending construction of the canopy it was necessary temporarily to suspend from July 12 to 16 the shipment via refrigerator car of certified beans from the Cedarville siding.

As adult beetles during their heavy flight in Philadelphia were sufficiently abundant to reinfest inspected commodities, the usual 24-hour daily inspection service in that city was discontinued from July 11 to August 13, 1934, and the hours of inspection were shortened to from 4 a. m. to 10 a. m.

As in 1933, green beans were again shipped in large quantities to drought-stricken midwestern markets from the bean-growing districts in southern New Jersey, in Morrisville and Bustleton, Pa., surrounding Baltimore, Md., and on the Eastern Shore of Maryland and Virginia. All beans shipped under certification from these areas were run through cylindrical inspection machines to rid them of beetles. Most of the 6,030 beetles removed from farm products inspected during the season came from the 512,837 hampers of beans run through the machines.

Disappearance of the adult beetle from agricultural sections producing quarantined fruits and vegetables led to the lifting, effective on and after September 16, of the seasonal restrictions on the movement of these articles. This action advanced by almost a month the October 15 date prescribed by the regulations for the termination of this particular regulatory activity. Cut flowers continued to be likely carriers of the adult beetle, so requirements for inspection and certification of this commodity continued until the later date.

Based on 1934 observations, which indicated the hazards of beetle spread peculiar to the movement of fruits and vegetables of all kinds by refrigerator cars or trucks from sections of heavy infestation to noninfested territory, there was issued, effective June 1, 1935, a thirteenth revision of the regulations to safeguard such commerce. Under the new regulations certification is required for fruits and vegetables of all kinds when moved via truck or refrigerator car from the District of Columbia, and those parts of Delaware, Maryland, New Jersey, Pennsylvania, and Virginia known to be continuously and, at peak



emergence of the insect, densely infested with the beetle. As a condition of certification of fruits and vegetables, other than onions and potatoes, moving via refrigerator car from the zone of flight, there are required inspection and loading in a manner to prevent infestation, in a refrigerator car with closed or adequately screened doors and latches, which car prior to loading has been determined by an inspector as thoroughly swept and cleaned by the common carrier in a manner to rid it of infestation. During the interval between cleaning and loading the car must be kept tightly closed and sealed. Fumigation, when deemed necessary by the conditions of beetle flight, is required in the case of onions and potatoes moving via refrigerator car from the same sections. No change in regulated area was involved in this revision of the regulations.

Tests were necessary to devise a method of fumigating refrigerator cars containing potatoes and onions shipped from heavily infested sections while the insect is in active flight. As finally devised, the equipment to be used consists of a pressure cylinder of liquid hydrocyanic acid with an applicator. By testing tips with various-sized holes, it was finally determined that one with a hole 0.002 inch in diameter would deliver 6 ounces of hydrocyanic acid in 1 minute under a pressure of 30 pounds. In practice the loaded refrigerator cars will be tightly closed, except for a narrow opening in one door through which a nozzle 3 feet long may be inserted. After discharge of the gas for 1 minute, the door is closed and the car sealed for a 2-hour fumigation period. Since adult beetles did not emerge during June in numbers sufficient to constitute a flight, this fumigation procedure was not employed during the present fiscal year.

Activities incident to the seasonal quarantine on fruits, vegetables, and cut flowers were fully organized on July 1, 1934. Inspectors were stationed at 37 inspection centers located at important shipping points throughout the regulated area. South-bound and west-bound trucks transporting fruits and vegetables from the heavily infested sections were required to report for inspection at platforms in Fredericksburg, Va., and Pittsburgh, Pa., respectively. This designation of inspection centers was occasioned by the fact that motor vehicles transporting certified products become infested with the flying beetles as the trucks proceed through the flight zone. With the scene of inspection transferred to a nonflight section, there were no such opportunities for reinfestation.

#### CERTIFICATES ISSUED, VIOLATIONS INVESTIGATED, AND PROSECUTIONS TERMINATED

In the course of the fiscal year a total of 484,427 certificates of all kinds were issued to cover products affected exclusively by the Japanese beetle quarantine.

Table 9 shows the quarantined articles intended for shipment from the regulated area and for use in certified greenhouses, or surface soil in nursery plots, heeling-in, or plunging areas, which were fumigated or sterilized during the 12-month period.

TABLE 9.—*Materials fumigated or sterilized under Japanese beetle quarantine regulations, fiscal year 1935*

Treatment	Plants	Potting soil	Mush-room soil	Leaf mold	Sand	Surface soil	Surface soil with plants	Berries	Bananas
	Number	Cu. yds.	Cu. yds.	Cu. yds.	Cu. yds.	Sq. ft.	Sq. ft.	Crates	Bunches
Arsenate of lead.....		74				76,768	1,600,254		
Carbon disulphide gas or emulsion..	10,046	2,390	80	6	3,252	27,415		1,987	
Naphthalene.....		56				27,881			
Steam.....		699							
Hydrocyanic acid.....									87,001
Hot water.....	3,192								
Paradichlorobenzene.....	6,865								

Nursery and ornamental stock, sand, soil, earth, peat, compost, and manure were certified for shipment from the regulated areas during the fiscal year in the following quantities:

Plants.....	number.....	25,455,327
Sand, earth, and clay.....	carloads.....	5,829
Peat.....	do.....	58
Manure and compost.....	do.....	164

Fruits, vegetables, moss, and cut flowers certified during the seasonal quarantine on these articles were as follows:

Fruits and vegetables-----	packages--	4, 020, 399
Moss-----	bales--	2, 678
Cut flowers-----	packages--	23, 102

Investigations were made of 1,361 apparent violations of the Japanese beetle quarantine regulations. These included interceptions by transit inspectors of the Bureau stationed at postal and common-carrier terminals and by highway inspectors examining road vehicles. In the course of the year prosecutions were successfully terminated in the United States district courts against 2 individual and 3 corporate violators.

#### TRANSFER OF HEADQUARTERS

Following transfer on September 10, 1934, of supervision of Dutch elm disease eradication work to L. H. Worthley, field headquarters of the Bureau directing Japanese beetle quarantine enforcement was removed in November from Harrisburg, Pa., to White Plains, N. Y. The new field headquarters is strategically situated in the areas jointly affected by the Japanese beetle, Dutch elm disease, and European corn borer, and is conveniently located near the gypsy moth infested zone.

#### COOPERATIVE ENTERPRISES

Four Canadian officials attended a tour of the heavily infested southern New Jersey territory on July 16, 1934, and the Syracuse, N. Y., district supervisor made field observations on the Niagara peninsular district with the Canadian officials preliminary to their 1934 trapping program. Cooperation was again accorded the Canadian Department of Agriculture in purchasing 500 Japanese beetle traps from a Philadelphia manufacturer.

Limited numbers of traps were operated for control purposes under State or municipal auspices in Delaware, Connecticut, Maryland, New Jersey, Rhode Island, and Massachusetts.

State appropriations were available for Japanese beetle quarantine or control operations in Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, and Virginia. Trapping operations in Maine, Indiana, Michigan, and Missouri were financed from funds allotted by the respective States or cities in which the work was performed.

### INSECTS AFFECTING FOREST TREES

#### COOPERATIVE SERVICE

As in the past, one of the most important activities of the Division of Forest Insect Investigations has continued to be the cooperative service rendered to the several Federal agencies administering timberlands, such as the Forest Service, National Park Service, and Bureau of Indian Affairs, as well as to such emergency agencies as the Civilian Conservation Corps, the conservation program of the National Recovery Administration, and the shelterbelt program. Private owners have also been aided, but to a lesser degree. This cooperative service, for the most part, consists in surveys of bark beetle infestation, estimates of loss, recommendations as to methods of control, estimates of the cost of such operations, and technical direction of control projects. It might be added that such duties have more than doubled within the last few years, owing to the increased activity in forest-insect control in connection with emergency activities.

#### CONTROL PROGRAMS

##### MOUNTAIN PINE BEETLE

In California the epidemic of the mountain pine beetle which started in the Yosemite National Park and adjacent forests in 1931 and took a heavy toll of the fine sugar pine has been brought under control. Other projects against the same beetle in lodgepole pine stands in Crater Lake and Mount Rainier National Parks have been entirely successful. In the Rocky Mountain region the mountain pine beetle still continues its alarming destruction in some areas, while in others it is on the wane. On the Coeur d'Alene and Kootenai National Forests the control efforts begun in 1930 have resulted in the preservation of the valuable commercial white pine stands.



## WESTERN PINE BEETLE

Encouraged by the results secured in recent years from well-planned extensive control operations the Forest Service, Park Service, Bureau of Indian Affairs, and private timber owners have been especially active during the last year in the control of the western pine beetle. In Oregon and Washington over 250,000 acres of pine timberland were covered with control work. A similar enthusiasm among both public and private protective agencies is also evident in California. In northern California the McCloud River Lumber Co. has committed itself to the policy of cutting and milling infested trees and destroying the infested bark. Although the timber thus salvaged contains considerable blue stain, there is a market for it, and from the standpoint of cost this method is much more advantageous than the wasteful one of burning the infested bark and leaving the logs to rot in the forests.

## OTHER BARK BEETLES

Control operations against the Black Hills beetle in several forests in Colorado, against the Douglas fir beetle in Wyoming, and minor operations against threatening infestations of several species of *Ips* in a number of localities have also been carried through.

## RESEARCH ACTIVITIES

Research work directed toward the development of more efficient and economical control methods against bark beetles has been continued, and in some cases slight modifications of previously used methods have led to excellent results. One such modification is based on the principle of preserving a larger percentage of the natural enemies of the mountain pine beetle, to bring about not only a numerical reduction of the pest but also a more favorable relation between parasite and host, thus assuring more lasting benefit from the control operation. Encouraging results have continued from experiments in killing bark beetles by means of penetrating oils applied to the bark and by the introduction of lethal materials in the sap stream of infested trees, but the methods are not yet sufficiently perfected to warrant their use in large-scale control projects.

The continued demand for nursery stock due to the remarkable activity of the reforestation program in connection with the Forest Service and with the various emergency activities, such as the erosion control work, the shelter-belt program, the Civilian Conservation Corps work, etc., has made the control of insects affecting forest nursery stock and newly established plantations of vital importance. Of the numerous insects important in these connections, the white grubs are by all odds the most destructive. A thorough investigation of these insects is under way, involving not only a study of their biologies, but also the development of control methods which will kill the grubs but will not injure the young trees. The nursery work is largely centered in the Southeastern States, while the work in plantations is centered in the Lake States.

The investigations on the locust borer in the Central States were continued along the line of preserving stands by means of stimulating new growth of trees from sprout growth following cutting of the badly infested trees and by mulching. The projects on the southern pine beetle, the white pine weevil, the beech coccus, the larch case bearer, the leaf-mining sawfly, the elm leaf beetle, and other native and introduced insect pests of trees in the East have also been considerably advanced. An extensive survey of the New England States to determine the occurrence of the balsam bark louse was made, and experiments in control, applicable to infested balsam trees used as ornamentals, were successfully conducted.

The work upon the insects associated with the Dutch elm disease has been greatly enlarged by the transfer of seven men to the Morristown, N. J., laboratory from the old Melrose Highlands, Mass., laboratory, and the employment of additional men on emergency funds. During the year a great amount of biological work has been done upon various insects found in elm, and much experimental work performed to determine insect vectors, with special reference to those which injure the bark either in feeding, ovipositing, or in the construction of brood burrows. During the year, as a result of field, laboratory, and greenhouse experiments, 50 cases of successful transmission of *Ceratostomella ulmi* by the smaller European elm bark beetle (*Scolytus multistriatus*)

tus Marsh.) from diseased to healthy trees have been recorded. Also in one case the disease has been isolated from a brood gallery made by the native elm bark beetle (*Hylurgopinus rufipes* Eichh.).

## GYPSEY MOTH AND BROWN-TAIL MOTH CONTROL

### FEDERAL AND STATE FUNDS FOR GYPSEY MOTH WORK

At the close of the fiscal year 1934, during which the work had been carried on under an allotment of funds from the Public Works Administration, it was necessary to reduce the field force so as to keep within the funds authorized by Congress for expenditure during the fiscal year 1935. These funds amounted to \$360,000. A small balance was available from the Public Works Administration project to close up the work that remained unfinished at the end of the fiscal year. During this period over 280,000 gypsy moth egg clusters were treated in a limited solid area in Bernardston, Greenfield, and Leyden, Mass., and 812,000 feet of Government barbed-wire fence enclosing sprayed areas was removed and stored.

To supplement the funds available it seemed advisable to obtain as much assistance of an emergency nature as was possible. Acting under the sponsorship of the Department of Agriculture of the State of Pennsylvania, the relief administrators of Luzerne and Lackawanna Counties set up gypsy moth projects, which continued somewhat intermittently from late in the fall of 1934 to the end of the fiscal year 1935. The Conservation Department of Massachusetts and the State forester of Connecticut also supplied details averaging 20 men each from Civilian Conservation Corps camps located in or near the barrier zone in New England. As a result of this help, together with the regular funds set up by the cooperating States, the year's program of work was carried through, the primary objective being to reduce the heaviest and most threatening infestations. Scouting work for protective purposes in the outlying portions of the barrier zone and in Pennsylvania was attempted in only a limited way on account of the small number of trained scouts that could be spared from other work.

### WORK IN AND ADJACENT TO THE BARRIER ZONE

This work was confined almost exclusively to territory in the southern part of Berkshire County, Mass., and in the northern part of Litchfield County, Conn., where small infestations had been found the previous year or where male moths had been caught at assembling cages during the previous summer. During the winter, 57 infested areas were located and 11,555 egg clusters were treated. This involved scouting of 83,071 acres of woodland and 373 miles of roadway. Two hundred and two acres of woodland were thinned, the most favored food plants removed, and the slash burned, and 3,547 acres of woodland were sprayed in June, burlaps being applied in the worst infested areas.

The New York Conservation Department, principally through enrolled men in Civilian Conservation Corps camps, scouted portions of Essex, Warren, Ulster, and Broome Counties west of the barrier zone and selected areas in Columbia and Dutchess Counties within the zone. No infestations were found in the counties west of the barrier zone in New York State, but 3 small infestations totaling 117 egg clusters were located in the town of Austerlitz, 1 infestation totaling 125 egg clusters in Hillsdale Town, and 2 rather serious infested points totaling 7,269 egg clusters in Dutchess County. These infestations were treated by the force supervised by the State conservation department and the areas were sprayed in June. Work was also carried on by that department in Nassau and Suffolk Counties, Long Island, and in the Borough of the Bronx, in New York. No infestation was found in Suffolk County, but in Nassau County 24 small infestations totaling 230 egg clusters were located in Oyster Bay Town and 18 infestations totaling 2,052 egg clusters were found in North Hempstead Town. Several square miles were found infested in the Bronx and 12,000 egg clusters were found and treated. All of the above areas were sprayed by the New York Conservation Department before the end of the fiscal year.

A Federal agent stationed at Roslyn, Long Island, certified 1,791 shipments of nursery stock and other material moving from the infested area on Long



Island. All of these shipments were free from infestation, except a single lot of cordwood on which one egg cluster was found. A limited amount of checking work was performed in a number of areas that had been scouted by the State force but no additional infestation was discovered.

#### GYPSY MOTH WORK IN CIVILIAN CONSERVATION CORPS CAMPS

In the area between the barrier zone and the Connecticut River, work has been carried on throughout the year by men allotted from 18 Civilian Conservation Corps camps. In most cases 20 men have been detailed from each camp for this work, which is carried on under the supervision of the gypsy moth office of the Bureau of Entomology and Plant Quarantine. One forest camp is located in Vermont, 5 in Massachusetts, and 7 in Connecticut, and, in addition to these, 5 camps under the control of the Department of the Interior are located in the Massachusetts area. This work is a continuation of that taken up during the previous fiscal year.

The average number of Civilian Conservation Corps men on the gypsy moth work on days when work was performed was 428. Owing to arrangements allowing for the making up of lost time on Saturdays, only 1.1 percent of available time was lost. This is a marked improvement over the record of the previous year, when 15 percent of available time was lost. During the year 103,445 6-hour man-days were used on the project, being some 26,000 more man-days than during the previous year. This increase in man-days made possible a large increase in the volume of work accomplished, especially hand control practices in severe infestations. The tree growth on a total of 407,653 acres of woodland and open country and along 1,441 miles of road was examined for gypsy moth infestation. This is slightly less than was accomplished the previous year, owing to the more intensive work done in infestations. Tabulations of the year's work show a large increase in accomplishments, with nearly a million individual trees examined and 4,685 destroyed. Fallen trees and branches and undesirable tree growth, also species particularly favored by the gypsy moth, were removed from 984 acres, leaving these stands less favorable for gypsy moth increase, and in better condition for future gypsy moth work. A total of 612,069 new egg clusters were found and treated. During May and June 1935, 396,933 trees were banded with burlap, and by the end of June 1,388,430 gypsy moth caterpillars were destroyed by men patrolling them. This type of work is seasonal and many more caterpillars will be crushed in July before the season is over.

The work has demonstrated the practicability of using Civilian Conservation Corps men for gypsy moth work in the area under consideration and has resulted in preventing large increases in the gypsy moth infestations in the area worked between the Connecticut River and the barrier zone and has materially decreased the danger of spread from this area into the zone.

During the year a large extension of the Civilian Conservation Corps gypsy moth work east of the barrier zone was proposed and, if put into operation, it will probably result in greatly extending this work for the coming year, although not to the extent requested.

#### WORK IN NEW JERSEY

On the northern rim of the area that was previously infested in New Jersey, several male moths were taken in the summer of 1934, in the townships of Mendham, Morris, and Randolph, and a single moth was captured in Pahaquarry Township near the Pennsylvania line. The State gypsy moth force carried on scouting work in the fall and winter in the first three townships and Federal agents were detailed to work in Pahaquarry Township and to scout certain sections in the townships previously mentioned near some of the cages where male moths had been captured the previous summer. In all, 3,612 acres of woodland were scouted and, in addition to this, 532 acres in the region of the Palisades near the George Washington Bridge, Fort Lee, N. J., were scouted by the State force. No infestation was found in Pahaquarry Township, but two locations, totaling 31 egg clusters, were discovered in Morris Township, and one consisting of 14 egg clusters was found on the Mendham-Randolph Township line. These areas were sprayed in June and a belt surrounding them, aggregating 178 acres, was also treated. The State and Federal forces cooperated in carrying through this work.

## WORK IN PENNSYLVANIA

With the Federal and State funds available in the Pennsylvania area and the assistance from Luzerne and Lackawanna Counties previously referred to, it was found possible to scout intensively flood areas within the infested territory along the Susquehanna and Lackawanna Rivers, assembling-cage sites where male moths were captured last summer, sites of previously located infestations in outside territory, and to do considerable scouting and creosoting in the generally infested area. Woodland areas were thinned and the slash was burned in sections where effective scouting could not otherwise be done, sprouts were removed from stumps in territory previously cut over, and the most dangerous areas were sprayed during May and June. Burlap bands were also applied in woodland and residential sections where considerable infestation exists. These burlaps were patrolled and all caterpillars found were destroyed.

In a total of 70 infestations found during the fiscal year 1934 in 15 lightly infested townships, only 10 were reinfested in 1935, and 5 of these were in localities where only single egg clusters were found during 1934 and where no spraying was done. In the other 5 the trees along the property lines were not sprayed because wind drift would have caused the spray to lodge in adjoining property not covered by permits.

During the year 8,698 shipments of quarantined forest products, nursery stock, and other materials were inspected and a total of 70 gypsy moth egg clusters were found and treated. There were a few quarantine violations, and in each of the cases prosecuted by the State the defendants were found guilty.

## SPECIAL SCOUTING

From the latter part of January to the last of April, special survey work was carried on with negative results west of the Hudson River in the extreme southeastern part of New York, in northeastern Pennsylvania adjacent to the New York and New Jersey State lines and the area where regular scouting work has been performed, in sections of northeastern and southern New Jersey where no scouting or cage work had previously been done, in New Castle County, Del., and in three townships in Cecil County, Md. The State authorities in these States and in Ohio were urged to do as much special survey work as time and funds would permit in territory where Federal work was not planned. Fifteen Federal experts were detailed to this work. They paid particular attention to trees and nursery plantings on large estates, around hotels, gasoline stations, cemeteries, and dumps; also in localities where large movable equipment used in construction work might have been used or stored. Although an average of not more than 4 days was spent in each town, the work was sufficiently well done so that it is believed any sizable infestation would have been noticed. The State of New Jersey furnished an inspector who worked with the Federal employee assigned to duty in that State. Pennsylvania and Ohio also did considerable work of this type. No infestation was found in any of the outlying territory.

## SPRAYING

During the spraying season more than 7,700 acres of woodland and 6,800 residential properties were treated in the Pennsylvania territory, and the other areas are indicated under the States concerned. This involved the use of 61 high-power spraying machines in the following States: Massachusetts, 11; Connecticut, 12; Pennsylvania, 27; New Jersey, 2. In addition to these, 9 sprayers were loaned to the conservation department of the State of New York for treating infestations on Long Island, in the Bronx, and in Austerlitz and Milan in the barrier zone.

The weather during the spraying season was not so favorable as usual and considerable time was lost on account of rain and wet foliage.

Assembling-cage work was conducted in Vermont, Massachusetts, Connecticut, and Pennsylvania.

## DEFOLIATION IN NEW ENGLAND

In the summer of 1934 defoliation caused by the gypsy moth was considerably in excess of that recorded for 1933. For the entire infested area a total of 492,861 acres of woodland with from slight to complete defoliation were found, as compared with 397,730 acres recorded for 1933. In general there was less



defoliation in the eastern part of the infested area than had been recorded in the several years immediately preceding. This was particularly true as to Barnstable and Plymouth Counties in Massachusetts. Beyond these sections the amount of defoliation increased considerably, particularly in New Hampshire, westward to the Connecticut River, and in Massachusetts from the central part of Worcester County to and beyond the above-named river. The records for the summer of 1934 showed that there was considerable increase in defoliation for Maine and New Hampshire. Massachusetts showed some decrease, owing principally to a decided decrease in the southeastern part of the State, which was not offset by a large increase farther west. There was a decided increase in the amount of defoliation in Rhode Island.

#### EFFECT OF DEFOLIATION ON FOREST GROWTH

Beginning about the middle of January 1935 an extended series of observations on the extent of gypsy moth infestation and damage caused to woodland was begun in several towns in the eastern part of Franklin County and the northwestern part of Worcester County, Mass. The purpose was to obtain accurate records of the degree of infestation, the types of growth, the natural conditions of the infested areas, and the amount of injury caused by defoliation. Areas were selected for which records of degree of defoliation in 1934 were available. One area was selected in Athol, 3 in Orange, 4 in Erving, and 8 in New Salem, Mass. This work has been under way for such a short time that it is hardly possible to draw very definite conclusions with respect to the effect of defoliation on all species of trees. It has been definitely established, however, that one complete defoliation is sufficient to kill hemlock, for in the Athol point 38 out of a total of 42 large trees of this species, ranging up to 55 feet in height, were killed by being completely defoliated in the summer of 1934. The other 4 trees in this group were not completely defoliated and still show signs of life. With respect to white pine, a section of the same point in Athol has quite a stand of small pines averaging about 5 or 6 feet in height. A count showed that one-sixteenth acre of this area contained 94 small pines. All of these were heavily defoliated in 1934, and at present 25 percent are dead and the remainder are in very poor condition. In all of the areas where white pines were selected within sections that were defoliated, these trees suffered injury, depending on the degree to which they were eaten. If they were completely defoliated they were killed. At a hill-side location in Athol 42 pines ranging in height from 30 to 35 feet have died as the result of complete defoliation in 1934. Most of these pines attempted to re-foliate after being stripped of their needles. Last winter they were more or less covered with the short, undeveloped new needles, but since then they have turned brown and are dead. For all of the 16 acres in which records are being taken the proportion of growth favored by the gypsy moth is rather high. In general, the growth most desirable for gypsy moth food consists in the main of white, red, black, and chestnut oaks, poplar, and gray birch. By actual and careful checks of the areas, which range in size from 2 or 3 up to 50 acres, these favored food plants comprise from 30 to 95 percent of the entire growth, the general average being between 60 and 70 percent. White pine and hemlock, which have been eaten so heavily, comprise from 5 to 60 percent of the woodland growth, the average probably being about 20 percent. The remaining growth, which might be considered only partially or not at all favored, consists of paper birch and red maple, with a scattering of other species. It can be seen, therefore, that for most of the area where the records are being taken the growth is, in the main, extremely desirable to this insect, and this fact is attested by the extent of defoliation that has taken place in those areas.

#### THE BROWN-TAIL MOTH

In general, there was a light-to-medium infestation of this species throughout practically all of the infested territory, but no instances of appreciable defoliation were reported during the summer of 1934. During the winter of 1934-35 numbers of winter webs were cut by the States in Maine, New Hampshire, and Vermont. For Maine only partial records are available, and this work was performed by men from three Civilian Conservation Corps camps. A total of 72,819 webs were cut and destroyed in 23 towns located mostly in the southern part of the State. In New Hampshire webs were cut in towns throughout the greater part of the infested area. A total of 1,548,287 webs

were cut and destroyed. Most of these were cut under the Emergency Relief Administration brown-tail-moth-removal project. A few were cut by men from Civilian Conservation Corps camps and a few more by the State entomologist. In Massachusetts a large proportion of the towns within the infested area were examined for webs and 169,352 were cut and destroyed. The winter was considered unfavorable for insect survival and these records indicate that persistent treatment will be necessary to keep this insect below a dangerous level.

## GYPSY MOTH QUARANTINE ENFORCEMENT AND CERTIFICATION

### REGULATORY CHANGES

Revised quarantine regulations were promulgated to become effective October 2, 1934. This involved the first change in the gypsy moth infested areas since 1931. On the basis of freedom from infestation as evidenced by the inspection of millions of Christmas trees over a period of years, supplemented by observations of district inspectors continuously stationed in the affected areas, it was possible to remove from the lightly infested territory in Vermont certain towns adjacent to the Canadian border and along the northwestern periphery of the infested zone. On the other hand, a number of towns in the lightly infested sections of Maine, New Hampshire, Vermont, and Connecticut were changed to heavily infested. This enlargement of the heavily infested section added a strip of territory from 1 to 3 tiers of towns wide on the northern boundary of the former area. Conditions of gypsy moth infestation in the affected towns were determined by special scouts of the gypsy moth quarantine unit and by Civilian Conservation Corps workers employed under the supervision of State officials. The finds were sufficient to justify these towns being considered heavily rather than lightly infested. The principal effect of this change in the administration of the quarantine is the embargoing of the movement of Christmas trees from these latter areas in which the trees formerly were eligible for certification after inspection. There were also a few minor changes in products affected by the certification requirements.

### CERTIFICATION OF QUARANTINED PRODUCTS

Routine demands for inspection and certification were met by a force of 21 inspectors. Each inspector was assigned to a district and was held responsible for all details of quarantine enforcement in his district. When Japanese beetle and gypsy moth certification was required, this joint inspection service also was provided by the district inspectors.

Quarries and nurseries in sections of the lightly infested area in which gypsy moth infestation had not previously been found were scouted for egg clusters. The nurseries concerned had previously been scouted and found free from the Japanese beetle. Determination of freedom from gypsy moth infestation of these establishments and their surroundings allowed them to receive permits for their shipments without detailed inspection of each article.

Christmas-tree inspection was performed from mid-November until December 15. Mild weather during much of this period facilitated examination of the trees. At the peak of the inspection early in December, 60 temporary inspectors were employed. During the 1934 shipping season there were certified 377 carloads of trees. In addition, 206 carloads were shipped from the 41 Vermont towns released from quarantine in October. This total of 583 cars shipped from the areas as previously regulated is compared with a total of 459 carloads certified therefrom in 1933. As the inspected trees all originated in the lightly infested area, only a single gypsy moth egg cluster was found.

Presence during the fall of large numbers of gypsy moth egg clusters on laurel led to a change in the procedure whereby this commodity was certified. Laurel branches in large quantities or after processing into roping, wreaths, or funeral pieces cannot be satisfactorily inspected. Therefore, actual inspection was limited to loose branches in small quantities. The bulk of this material was inspected on the lot basis. In this manner, entire uninfested sections within which it was safe to pick laurel were designated after thorough scouting of the localities. Shippers desiring to manufacture decorative articles containing laurel for movement under certification were given certificates for material obtained from these uninfested sections.

From early in October until the first week in December, inspections were made of 161 lots from which evergreen boughs were gathered for shipment.



The scouted lots, totaling approximately 10,000 acres, were located in the lightly infested gypsy moth area of western Massachusetts and southern Vermont. All inspections gave negative results. A total of 30,700 bales of boughs was certified for movement from these lots.

The quantities of articles of the respective quarantined products certified during the fiscal year are summarized in tables 10 to 13. The number of gypsy moth egg clusters removed from inspected products showed a 350-percent increase over the preceding year.

TABLE 10.—*Nursery stock certified under gypsy moth and/or Japanese beetle quarantines, fiscal year 1935*

Material	Quantity	Certificates issued	Gypsy moths found	
			Egg clusters	Larvae and pupae
		Number	Number	Number
Shrubs.....	696,460	5,756	2	0
Specimen trees.....	54,438	1,149	0	0
Young trees.....	167,413	1,078	3	0
Specimen evergreens.....	84,688	1,801	0	0
Young evergreens.....	1,690,794	6,579	7	0
Seedlings, cuttings, and small plants.....	943,676	3,823	0	7
Potted greenhouse plants.....	32,648	922	0	0
White pine trees.....	85,179	145	1	0
Total.....	3,755,296	21,253	13	7

TABLE 11.—*Evergreen products certified under gypsy moth quarantine, fiscal year 1935*

Material	Unit	Quantity	Certificates issued	Gypsy moths found	
				Egg clusters	Larvae and pupae
			Number	Number	Number
Boughs, balsam twigs, and mixed greens.....	Box or bale.....	39,514	5,370	0	0
Christmas trees.....	Number.....	888,189	214	0	0
Laurel.....	Box or bale.....	13,561	3,423	12	0
Miscellaneous.....	Box.....	5,470	713	0	1
Total.....			9,720	2	1

<sup>1</sup> In addition, 30 larvae of the brown-tail moth were removed from laurel.

TABLE 12.—*Forest products certified under gypsy moth quarantine, fiscal year 1935*

Material	Unit	Quantity	Certificates issued	Gypsy moths found	
				Egg clusters	Larvae and pupae
			Number	Number	Number
Barrel parts, crates, crating.....	Bundle or case.....	2,585	1,194	1	0
Logs, piles, poles, posts, ship knees, and ties.....	Piece.....	269,350	3,954	50	2
Fuel wood.....	Cord.....	2,943	996	225	0
Pulpwood.....	do.....	35,948	1,491	27	0
Lumber.....	Board feet.....	23,502,078	2,455	1,321	140
Empty cable reels.....	Number.....	32,744	3,057	0	0
Shavings.....	Bale.....	24,021	141	0	0
Shrub and vine cuttings.....	Box.....	426	167	0	0
Miscellaneous.....	Number.....	955,812	701	5	0
Total.....			14,156	1,629	142

TABLE 13.—*Stone and quarry products certified under gypsy moth quarantine, fiscal year 1935*

Material	Unit	Quantity	Certificates issued	Gypsy moths found	
				Egg clusters	Larvae and pupae
			Number	Number	Number
Crushed rock.....	Ton.....	927, 190	1, 354	0	0
Curbing.....	Running feet.....	50, 208	155	0	0
Feldspar.....	Ton.....	4, 856	239	0	0
Granite.....	Piece.....	46, 546	2, 855	12	8
Do.....	Running feet.....	72, 700	30	0	0
Monumental stone.....	Piece.....	13, 179	9, 526	1	0
Grout.....	Ton.....	13, 768	413	0	0
Marble.....	Piece.....	22, 245	88	0	0
Paving blocks.....	Number.....	1, 817, 692	476	368	167
Miscellaneous.....	Piece.....	27, 475	539	0	0
Do.....	Ton.....	4, 693	30	0	0
Total.....			15, 705	371	175

<sup>1</sup> This does not include 28 egg clusters found on cleating and blocking used to secure granite on cars.

### ROAD PATROL

Highway inspection on roads leading from the lightly infested sections to nonquarantined territory started with the stationing of an inspector on the Mohawk Trail near Savoy, Mass., on September 12. The first interception of a gypsy moth infested plant was made on September 24. From October 15 to 27, 13 additional posts were established—3 in Massachusetts and 10 in Connecticut. Early in November five posts were established on the border of the lightly infested area in Vermont. Closing of all posts was accomplished between December 3 and 22. Two supplemental posts were operated in southeastern Connecticut for short periods just prior to the discontinuance of this work. When operating at their full capacity, these posts were manned by 53 road inspectors. Six infested lots of material were halted at the posts and found to contain 1 broken and 26 normal egg clusters. Just prior to closing of the posts for the season, a truck containing 138 uncertified Christmas trees was stopped while en route from Lewiston, Maine, to Jamaica, Long Island. Examination of about one-third of the trees disclosed 20 gypsy moth egg clusters. The entire load was ordered returned to the generally infested area. Another important interception led to the discovery of 75 egg clusters on cordwood already trucked to Port Chester, N. Y., a point outside the quarantined zone.

### VIOLATIONS

Investigations were made of 416 apparent violations of the gypsy moth and brown-tail moth quarantine. In the Bureau's first prosecution for violations of the gypsy moth quarantine in over 10 years, a commercial shipper and a common carrier were each fined for the shipment and transportation of uncertified fuel wood from Harrington, Maine, to Elkins Park, Pa. A third prosecution was pending in the United States District Court of Southern New York at the end of the fiscal year.

### BROWN-TAIL MOTH SCOUTING

Observations by district inspectors disclosed scattered infestations of the brown-tail moth in Orono, Maine, and two small infestations in Old Town, Maine. Both of these towns are outside the brown-tail moth regulated zone, but within the lightly infested gypsy moth restricted zone.

### SATIN MOTH SCOUTING

Scouting for satin moth egg clusters beyond the boundaries of known infested territory was performed late in July and early in August. Poplar and willow trees were examined for presence of the egg masses. At the conclusion of the



survey, infestations had been found in seven towns in which the moth was not previously known to exist. One of the new infestations is in southeastern Connecticut, 2 are in New Hampshire, and 4 are in Maine.

Within the infested section, satin moths were noticed depositing egg masses at Concord, N. H., as early as June 6. In northeastern Maine moths were found ovipositing as late as August 2. District inspectors in New Hampshire and Maine observed very little satin moth feeding, as compared with the 1933 defoliation. In some localities where large numbers of hibernating larvae were noted in the fall of 1933 there were no signs of feeding in the summer of 1934. Satin moth egg clusters were not as numerous in the quarantined zone as they were in the summer of 1933.

By arrangement with the Division of Foreign Plant Quarantines, an inspector from the port inspection office at Seattle, Wash., was detailed from July 22 to August 12 to scout a tier of counties in central Washington east of the area in the State designated as satin moth regulated area. Observations were confined to black cottonwoods and willows, the host trees of the insect in the Pacific Northwest. Three weeks' scouting in Klickitat, Yakima, Kittitas, Chelan, and Okanogan Counties gave negative results.

## DUTCH ELM DISEASE ERADICATION

### SYSTEMATIC SCOUTING

At the outset of the fiscal year elm trees confirmed as infected with the Dutch elm disease (*Ceratostomella ulmi* (Schwartz) Buisman) numbered 2,012 in New Jersey, 8 in Connecticut, and 1,235 in New York. This total of 3,255 diseased trees had been discovered as a result of scouting operations carried on in a tri-State area of 1,400 square miles since the disease was first detected at Maplewood, N. J., in June 1933.

Systematic scouting, already under way for several weeks on July 1, 1934, continued until the end of August, when reduced funds necessitated dismissal of Federal scouts. Scouting was continued in New York with men employed on State funds until brisk autumn winds in October defoliated the elms and forced abandonment of foliage scouting for the season. Before discontinuance of summer scouting, all of the originally known infected area in New Jersey and Connecticut had been surveyed twice, and the New York State scouts had finished a partial third survey. Discovery of infection at points near the margin of the infected zone required several extensions of the 10-mile protective zone included as an additional work area circumscribing the known infections. It was principally in these extensions that scouting was hurried and incomplete.

Definite and severe wilting of elm foliage, later confirmed as Dutch elm disease infection, was first observed during the summer of 1935 in the Bronx, New York, N. Y., on May 16. Systematic scouting from that date to the end of June resulted in the finding of 904 additional cases of infection, 559 located in New Jersey, 341 in New York, and 4 in Connecticut.

### EXTENSION OF WORK AREA

Discoveries of infected elms at points beyond the previously known diseased area were made during July, August, and September 1934 at 6 points in New York, 4 locations in New Jersey, and 3 towns in Connecticut. New Jersey finds were made 3 miles north of Hopewell in Montgomery Township, Somerset County; at Petersburg, in Morris County; at Echo Lake, in Passaic County; and at Princeton, in Mercer County. The most remote infections found in New York during 1934 were at Katonah, Cross River, and Crugers, in Westchester County; Stony Point and Sloatsburg, in Rockland County; and just west of the Suffolk-Nassau County line near the village of Central Park on Long Island. Contiguous to the 1933 known infected zone in Connecticut, new infections were found in Norwalk and about 4 miles north of the village of Fairfield, both points in Fairfield County.

New finds at points isolated from the tri-State zone of infection comprised 1 infected tree in Old Lyme, New London County, Conn., 4 in Indianapolis, Ind., and 1 in Norfolk, Va. As a result of 1934 scouting in Cleveland, Ohio, where the disease was found in 1930, 1931, and 1933, two additional infected trees were removed.

Included in the tri-State infected zone at the end of the fiscal year was a total of 2,478 square miles, of which 1,402 square miles were in New Jersey,

852 in New York, and 224 in Connecticut. This was an increase of approximately 1,075 square miles over the area known to be infected at the end of the previous fiscal year. The 10-mile protective zone in which scouting and sanitation work were also performed amounted to an additional 2,170 square miles, making a total work area of 4,648 square miles.

#### PROGRESS IN REMOVAL OF DISEASED TREES

Just prior to the 1934 field scouting, 1,487 infected trees had been removed and 5 trees known to be infected were standing. This was the nearest approach to complete removal of infected trees accomplished up to that time. As the summer's scouting progressed the number of standing infected trees increased, until at the end of July there were 2,983 infected trees still standing. Cases of infected trees numbered 1,682 in July, 1,998 in August, 391 in September, and 228 in October. When determinations of infection began to decrease in September an opportunity was afforded for reducing the number of standing infected specimens. With the exhaustion in September of New Jersey funds allotted for removal of infected trees, there still remained at the end of 1934 a total of 1,325 infected trees, 1 of which was in Connecticut, 4 in New York, and the remainder in New Jersey. Eradication crews organized under the allotment of P. W. A. funds available late in December soon reduced the number of infected trees as the sanitation work progressed throughout the affected territory. By February 2 the few remaining infected trees in Connecticut had been felled and burned. New York was entirely free from standing infected elms by March 30. In New Jersey, all elm trees that could be confirmed by laboratory diagnosis were eradicated by April 15. Laboratory cultures made from dead and dying trees removed during November and December and in the course of the large-scale sanitation program extending from December 28 to May 10 determined 416 cases of Dutch elm disease. Scouting by the permanent personnel and newly trained scouts placed in the field under the work-relief program in June located 891 additional infections. With this addition of 5,606 confirmations of infection during the fiscal year, the total of diseased trees detected thus far in the major infected zone increased from 3,255 to 8,861.

#### QUARANTINE RESTRICTIONS TO PREVENT ENTRY OR DISSEMINATION OF INFECTION

Foreign Quarantine No. 70, originally effective October 21, 1933, to regulate the importation from Europe of elm logs or elm material with bark attached, was amended, effective January 1, 1935, to place an embargo against the importation of elm veneer logs. Domestic Quarantine No. 71, effective February 25, 1935, imposes a rigid embargo on the movement of all plants or parts of plants of all species of the genus *Ulmus* from the known diseased area in Connecticut, New Jersey, and New York. State quarantines prohibiting the intrastate movement of host material from infected sections are also in operation.

#### COOPERATIVE ENTERPRISES

Under cooperative agreements between the Bureau and the infected States, each organization has accepted certain definite phases of the work. Scouting for the purpose of locating diseased trees and dead or dying elms is designated as a Federal activity. Culturing of twigs from elms suspected of harboring infection is performed by employees of this Bureau working under the supervision of the technician in charge of the laboratory of the Division of Forest Pathology, Bureau of Plant Industry, at Morristown, N. J. Information concerning infected specimens is turned over to the State control organization. State officials then contact owners of diseased, dead, or moribund trees to secure permission for removal. Most of the tree removal in New York and New Jersey was performed under contracts let by the State projects to commercial tree firms, municipal shade-tree commissions, and other organizations experienced in this type of work. A number of eradication crews were also employed on State funds. Insofar as funds were available, the few diseased trees requiring removal in Connecticut were felled and burned by town authorities. In New Jersey, contracts for diseased-tree eradication rapidly exhausted the \$30,000 appropriation and the State eradication program was halted on September 15. New York State continued its removal of infected trees, but



in Connecticut and New Jersey felling and burning of diseased trees was taken over as a Federal activity with the inauguration of the Bureau's sanitation program in January.

Finances to carry on scouting and eradication were obtained from a variety of sources. Available at the beginning of the fiscal year was a regular Bureau appropriation of \$150,000 and an allotment of \$6,000 from the National Recovery Administration. On December 21, 1934, a fund of \$667,000 was allotted to this work by the Public Works Administration. As the regular appropriation bill contained a clause providing that the Dutch elm disease appropriation could not be augmented by emergency funds of Federal origin without reimbursing the Treasury for the amount so added to the regular appropriation, up to the total of that appropriation, the emergency funds actually expended amounted to \$527,000. These emergency funds were exhausted in May 1935. On May 28, an allotment of \$250,000 was approved from work-relief funds. Reorganization of the project on a work-relief basis was in progress at the end of the fiscal year.

State appropriations of \$30,000 each were available at the beginning of the fiscal year in New Jersey and New York. In August 1934 an additional New York appropriation of \$142,500 for Dutch elm disease control work became available. New Jersey funds were largely exhausted by the middle of August 1934, and not until the following June were further New Jersey funds allotted to Dutch elm disease eradication. On June 8 a State emergency appropriation of \$25,000 became available in New Jersey for scouting and eradication activities. Several Connecticut garden clubs cooperated in employing scouts to survey their respective towns.

#### ELM SANITATION ACTIVITIES

When emergency funds allotted by the Public Works Administration became available on December 28, 1934, it was possible to build up an organization capable of quickly eradicating all standing, infected trees, and in addition make heavy inroads on dead and dying elms existing in the major diseased section. Decision to remove the latter type of trees was justified by the fact that they constitute potential sources of infection or are possible breeding places for the known vectors of the disease. Under conditions prescribed for employment on public-works funds, suitable men were selected from among those registered at the offices of the National Reemployment Service in the counties where the work was performed. As many experienced tree surgeons and tree climbers were unemployed during the winter, an efficient corps of workers was assembled. By the end of January 791 temporary men had been employed. Workers paid from emergency funds reached a maximum of 1,174 just prior to dismissal of the sanitation force on May 10 because of lack of funds. With disbandment of the crews, most of the Federal sanitation work was discontinued until reorganization of the work on a relief basis was begun in June 1935. The State of New York assisted in this work by taking over 144 eradication-crew members for 10 days, starting May 25. In furtherance of this work during Federal inactivity, an emergency New Jersey appropriation was available on June 8 for the employment for a period of 3 weeks of twenty-five 6-man eradication crews and fifty 2-man scout crews.

By the end of the fiscal year, scouts had tagged some 690,000 dead or dying trees, with the additional marking for destruction of 335,000 miscellaneous elm units, comprising stumps, slash, logs, and fuel wood. When eradication crews were operating at capacity in March and April their weekly production frequently exceeded 20,000 trees and 14,000 miscellaneous units. In the course of the 4½ months' intensive sanitation program eradication crews removed or destroyed approximately 460,000 dead and dying trees and 160,000 stumps or other miscellaneous units. This left at the end of the fiscal year a residue still marked for destruction of 230,000 trees and 175,000 other elm units.

Men assigned by the Civilian Conservation Corps to Dutch elm disease eradication under the supervision of Bureau employees were a major factor in much of the elm-sanitation work performed in woodland areas. At the end of the year approval had been granted for the construction of 3 Civilian Conservation Corps camps in New Jersey, 2 in New York, and 1 in Connecticut. When fully organized, these camps will be devoted exclusively to Dutch elm disease control activities.

Coordination and active direction of the work were supplied by a skeleton force of federally appointed men. This reached a maximum of 179 at the

peak of the summer season, following which the number was reduced to about 30 for the second quarter. With organization of the sanitation work early in 1935 the permanent force was increased to around 60.

#### INFORMATIONAL ACTIVITIES

Publication in March of a 4-page circular, *The Dutch Elm Disease Eradication Project: Federal, State, and Local Cooperation*, assisted materially in responding to the hundreds of communications received from individuals and city and town officials, garden clubs, and civic organizations expressing a lively interest in combating the disease now threatening the American elm. Circulars or bulletins were issued on the subject by the New Jersey and Connecticut Agricultural Experiment Stations and the New York State College of Agriculture. There has been a constant demand for educational mounts showing the characteristic symptoms of the disease and specimens of its principal known insect vector. This has been met by distribution of mounts containing well-labeled specimens of sterilized elm wood showing characteristic streaking, together with specimens of *Scolytus multistriatus* Marsh. and examples of this beetle's engravings.

#### WHITE PINE BLISTER RUST CONTROL

As a result of an allotment of funds by the Public Works Administration in August 1933 and the assignment of a large amount of labor from the Civilian Conservation Corps, more extensive areas of white pine were given protection against blister rust during the past year than in any similar period since the work was begun about 18 years ago.

Control measures consist of destroying currant and gooseberry plants (*Ribes*) growing in or near the pine stands, and local protection by this means is effective. Regardless of the intensity of the disease in the vicinity, blister rust cannot attack pine if there are no currant or gooseberry plants within the infecting distance of 900 to 1,500 feet of the pine, except that the cultivated European black currant is so susceptible that it is necessary to destroy it throughout the white pine regions, particularly when within a mile of white pine stands.

The pine areas to be protected in the United States total about 14,200,000 acres, and the border zones increase the areas from which currant and gooseberry plants must be removed to about 24,800,000 acres. In the Northeastern States about three-fourths of the control areas have been given initial protection; in the Western States about one-third; in the southern Appalachian States about one-fifth; and in the North Central States less than one-half. In 1934 in the country as a whole, 200,169,993 currant and gooseberry bushes were destroyed on 3,358,209 acres of white pine land with 932,916 man-days of labor. The Civilian Conservation Corps supplied 525,366 man-days of labor for this work and destroyed 83,779,865 currant and gooseberry bushes on 946,717 acres of land. The remainder of the work was performed with P. W. A., State, and local funds. Over 20,000 men were employed on control work, about half of whom were Civilian Conservation Corps enrollees assigned to this project from 267 camps. The work was carried on in cooperation with 31 States and with Federal agencies responsible for the administration of public lands. The results are given in table 14.

TABLE 14.—*Ribes*-eradication operations for the calendar year 1934

Region	Total pine area of sufficient value to justify protection	Control area (including border zones)	Area covered in 1934	Effective labor in 1934	<i>Ribes</i> destroyed in 1934
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Man-days</i>	<i>Number</i>
Northeastern States.....	7,600,000	12,842,240	813,073	219,393	23,133,684
Southern Appalachian States.....	1,100,000	5,353,500	1,157,885	22,056	2,354,377
Lake States.....	600,000	1,692,585	500,220	148,732	40,231,329
Western white pine (Idaho, Washington, Montana, including Mount Rainier).....	2,700,000	2,710,129	670,257	474,108	113,694,311
Sugar pine (California and Oregon).....	2,200,000	2,200,316	216,774	68,627	20,756,292
Total.....	14,200,000	24,798,770	3,358,209	932,916	200,169,993



Pine-disease surveys are conducted to a limited extent each year as opportunity arises. The purpose of these surveys is to determine the point at which local control measures should be instituted in the immediate future. The discovery of blister rust in a new section means that the white pines in that section can be expected to suffer serious loss unless local control measures, including *Ribes* eradication, are promptly carried out.

Continued spread of the rust in the East was evidenced by the finding of the disease on white pine for the first time in Sussex and Passaic Counties, N. J.; Allegany and Garrett Counties, Md.; Pendleton County, W. Va.; Geauga County, Ohio; Dubuque County, Iowa; Becker County, Minn.; Chippewa, Jackson, Marathon, Oneida, Adams, and Lincoln Counties, Wis.; and in Ontonagon, Leelanau, Emmet, Otsego, Alcona, and Sanilac Counties, Mich. Infection on *Ribes* was found for the first time in Nelson County, Va., and in Frederick and Montgomery Counties, Md.

In the West a new pine infection center was located on Steamboat Creek, Douglas County, Oreg., about 100 miles from California, but scouting in the sugar pine forests of northern California failed to reveal the presence of the rust. In the western white pine region of northeastern Washington, northern Idaho, and northwestern Montana, 39 new centers of pine infection were reported, making a total of 129 for the region. All of these have developed within the last 12 years and there are undoubtedly many others still undiscovered. Of the 39 new centers, 8 were in northern Idaho and northeastern Washington on the Kaniku National Forest, 1 on the Lolo National Forest, and 4 on the Cabinet National Forest in Montana. This is the first record of pine infection in Montana and in these national-forest units.

Careful inspection and study of white pine areas show that very little new infection is occurring on white pines in the areas that have been brought under control by the eradication of *Ribes*, but in similar unprotected areas the rust is increasing rapidly and causing serious losses in white pine stands, particularly among the younger age classes. This steady spread and intensification of the rust in unprotected areas is indicative of the need for vigorous and continuous application of control measures to protect the valuable white pine forests of this country.

Since the European or cultivated black currant (*Ribes nigrum*) is more susceptible to blister rust than any other species of *Ribes*, and is one of the chief agents in its long-distance spread and local establishment, the eradication of this plant in white pine regions is a general control measure that will be of material aid in checking the spread of the disease. During the past season 70,927 of these plants were eradicated in six Northeastern and Lake States. This work has been completed in Rhode Island and in large parts of several other States. In the Appalachian region black currants are very scarce, and in the West they have been eradicated in the western white pine and sugar pine regions.

In order to prevent the distribution of the disease through the movement of infected white pine planting stock, *Ribes*-free zones are established and maintained around nurseries in cooperation with the owners. In establishing these zones all *Ribes* are eradicated within 1,500 feet and all cultivated black currants within 1 mile of the nurseries. These zones are kept free of *Ribes* by yearly inspection and reworking where necessary. During 1934 this work was carried on around 74 nurseries in 18 States, thus affording protection for millions of white pines being grown for forest and ornamental planting. The number of these nurseries certified as having completely protected pines that could be authorized for interstate shipment is discussed in the report of the Division of Domestic Plant Quarantines.

Pre-eradication surveys were completed on 2,041,487 acres, of which 821,223 acres were in the eastern white pine regions, and 1,220,264 in the western white pine and sugar pine regions. This work makes it possible to determine the location, the acreage, and the *Ribes* conditions on areas having sufficient white pine values to warrant their protection from blister rust. The results of this work make it possible to decide on the eradication methods that will accomplish most on each area and to make a reasonably close estimate of the amount of work necessary to establish control.

A survey of forest lands in Colorado and Wyoming was initiated in 1934 to determine the distribution and value of white pines in these States and to ascertain the number and species of *Ribes* occurring in these stands as a basis for applying control measures. The forests of these two States aggregate about 31,500,000 acres within the boundaries of 24 national forests, 3 national

parks, and 1 Indian reservation. So far the results of the survey show that there are over 4,250,000 acres on 12 national forests, 3 national parks, and 1 Indian reservation supporting white pine, and that over 500,000 acres of this area support comparatively valuable white pine stands. The white pines consist of three species—*Pinus flexilis*, the limber pine, which occurs throughout the timbered areas of both States; *P. albicaulis*, the white-bark pine, found in northwestern Wyoming; and *P. aristata*, the bristlecone pine, which occurs in all the forests of Colorado except the extreme northern and northwestern ones. The commercial value of these white pines was not great, although they provide railroad ties, mine props, lumber, fence posts, and fuel wood for local use. In addition, they are very valuable for the protection of watersheds, the prevention of soil erosion, and the sheltering of wildlife, and for recreational and scenic areas. There are 11 species of *Ribes* in this region. In abundance they range from 1 to 38 bushes per acre in the upland types and from 18 to 279 bushes per acre in the moist stream bottoms. It appears that on the areas supporting good white pine stands the control of blister rust by *Ribes* eradication would be practicable at a moderate cost.

### WHITE PINE BLISTER RUST QUARANTINE ENFORCEMENT

An increased demand for white-pine stock was noted by nurserymen applying for Federal shipping permits last year. Commercial nurseries inspected for Federal certification in the spring of 1935 were found to be practically sold out, and this Bureau has received more applications for permits from Federal and State nurseries than in previous years. The practicability of growing rust-free pines in infected regions, under the sanitation requirements of the white pine blister rust quarantine, has been demonstrated. The quarantine requires *Ribes*-free zones for the growing of five-leaved pines in infected States for interstate shipping under Federal permit. After a nurseryman effects eradication of currant and gooseberry plants within the specified zones, under the leadership of trained State and Federal blister rust control agents, an inspector of this Bureau makes a search for any remaining sprouts or seedlings, and the crew may be required to cover the area repeatedly before the nursery is finally certified. Each year thereafter the environs are inspected for sprouts, seedlings, or home plantings of currants and gooseberries in the sanitation zones. Twenty-eight nurseries, including State nurseries of Idaho, Virginia, and Ohio, and United States Forest Service nurseries in West Virginia and Montana, were certified during the fiscal year and were granted pine-shipping permits. A third Forest Service nursery, having destroyed several thousand *Ribes* seedlings in the surrounding zones, was approved for white pine seedling.

The quarantine was amended, effective March 15, 1935, to require that shipments of currant and gooseberry plants to Minnesota must be accompanied by a control-area permit from that State. Such action was in recognition of a recent Minnesota regulation setting aside two pine-growing areas in which no currant or gooseberry plants may be grown. Ten States have now set aside such areas, legally established, and the Federal quarantine regulations provide that no *Ribes* may be shipped to these States without a control-area permit from the quarantine officer of the State of destination.

Transit inspectors enforcing quarantines at railway terminals intercepted 73 violations during the fiscal year, and vehicular inspectors of the Japanese beetle force reported 140 interceptions of auto tourists transporting uncertified white pines from blister rust infected States. At terminal stations the restricted plants were turned back to the senders. At roadside stations they were seized and destroyed. California State officers reported the interception of European black currants arriving from Utah. New Jersey State officers furnished information as to an individual hauling uncertified native white pines from New York State for sale. The State officers were able to check this hauling.

### CEREAL AND FORAGE INSECTS

#### GRASSHOPPERS

During the fall of 1934 an extensive survey of grasshopper conditions was conducted in cooperation with the 18 States included in the control campaign which was completed during the summer. This survey indicated a great reduction in grasshopper populations over most of the area included in the



control campaign. The heaviest infestations were centered in Michigan, Wisconsin, Minnesota, North Dakota, and Montana, but grasshoppers occurred in sufficient abundance to require control in the States of South Dakota, Iowa, Colorado, Wyoming, Kansas, Arizona, Idaho, California, Nevada, and New Mexico. A considerable portion of this reduction in populations, compared with 1934, may be attributed to the success of the control campaign. The infestation in the northern part of North Dakota and Minnesota was undoubtedly increased by migrations of grasshoppers from Canada. The requirements of the various infested States for control in the spring of 1935 were successfully met with the funds and materials available.

#### CHINCH BUG

After the completion of the control campaign late in the summer of 1934, a survey of chinch bug abundance was conducted, cooperatively with various States in the Corn Belt, to determine their probable abundance in the spring of 1935. This survey revealed the presence of the highest overwintering populations of chinch bugs on record in Ohio, Indiana, Illinois, Missouri, and Iowa, and populations of menacing proportions in the States of Oklahoma, Kansas, and Nebraska, and in southern Minnesota, Wisconsin, and Michigan. A considerable increase in the area covered by the infestation was also observed. Recognizing the emergency nature of this situation, should spring weather conditions be favorable for chinch bug development, Congress appropriated \$2,500,000 for the control of these insects. The very cold, wet spring delayed migration until after June 30, the indications being that, although severe local outbreaks could be expected in some of the States involved, the extremely wet weather over most of the area had reduced the outbreak to a level at which it was not so serious as that occurring in 1934. In Oklahoma, Kansas, and Nebraska the infestation was practically eliminated. Detailed studies on improving barrier methods and materials, and in determining methods of preventing severe infestation by reducing or eliminating certain of the small grains are being made, and more accurate methods of evaluating chinch bug abundance have been developed.

#### EUROPEAN CORN BORER

In the summer of 1934, in addition to the usual abundance surveys made in selected areas known to be infested, a survey was conducted to discover any extension of European corn borer invasion around the margins of the known infested area. This survey revealed only minor spread of the borer during the past 2 years. Damage surveys indicated extensive loss to sweet-corn growers along the eastern seaboard, particularly in Massachusetts and Connecticut, and on Long Island. An increase in infestation was noticed in New Jersey and in two counties on the Eastern Shore of Virginia. However, the infestations in the one-generation area in western New York, Ohio, and Indiana has maintained approximately the same degree of severity for the past 3 years. During this period climatic conditions have been definitely unfavorable to corn borer increase.

Varieties of field corn resistant to corn borer attack have been further tested and have maintained their resistance to the borer. In cooperation with the Bureau of Plant Industry, further crosses have been made of these resistant varieties, and an effort is being made to discover new resistant characters and new strains resistant to the borer. This work has now been extended to studies of resistance in sweet corn for utilization in the sweet-corn canning areas and market producing centers.

#### ALFALFA APHID

Resistance of alfalfa to the attack of the alfalfa aphid, approaching absolute immunity, has been definitely proved in a number of strains selected from varieties of alfalfa widely grown in Kansas and California. These strains have been carried through a number of generations and subjected to severe test. Results indicate that resistance is inherited. Repeated attempts to isolate strains of aphids that are able to survive on the resistant plants have resulted in failure. An effort is being made, in cooperation with the Bureau of Plant Industry, to develop strains of alfalfa having desirable agronomic characters combined with resistance to aphid attack.

## WHITE GRUBS

A new laboratory has been established at Madison, Wis., for the purpose of studying the various species of white grubs infesting Wisconsin and surrounding States, to supplement similar work under way in Indiana. Although the wet season greatly reduced the amount of white-grub damage experienced, as compared with that occurring in 1934, this is still a major problem in the production of good pastures and a number of grass crops. Studies on the feeding habits of the beetles have indicated that they feed widely on a number of herbaceous plants scattered throughout pastures and cultivated areas, in addition to the foliage of certain trees and shrubs. This observation has an important bearing on the possibility of control of the beetles by spraying shrubs and trees on which they were previously believed to depend almost exclusively for food.

## HESSIAN FLY

Studies to determine the best date of seeding to prevent hessian fly damage to wheat have been completed and discontinued in most of the area included in the middle Great Plains States. Determination of the best date of seeding has not yet been accurately made for the Eastern States, and date-of-seeding plots are still being maintained in this region.

Extensive tests of a large number of varieties and strains of wheat, to determine their resistance to hessian fly attack, have been conducted in California, Kansas, and Indiana, with the result that a few varieties have been found to be practically immune. It has been definitely determined that this characteristic is transmitted to succeeding generations. Breeding work is in active progress, in cooperation with the Bureau of Plant Industry in all three States, in an attempt to develop strains of wheat that will have satisfactory agronomic qualities for the various areas and also the fly-resistant quality. A technique for artificial infestation with the fly has been developed which will greatly speed up the process of selection, particularly in the areas where hessian fly outbreaks are sporadic.

It has been proven that little barley (*Hordeum pusillum* Nutt.), a common and widely distributed wheat-field grass, and other wild grasses are commonly infested with the hessian fly and may serve as reservoirs of infestation for wheat.

A number of native parasites of the hessian fly have been distributed during the year to areas in which they were not previously established, and one European species was introduced.

## HAIRY VETCH BRUCHID

A serious pest of the vetches has gained a firm foothold in the Atlantic States. This has been called the hairy vetch bruchid, but it also infests the smooth varieties of vetch as well as other closely related plants. This insect is a native of Europe and was first discovered in this country at Haddon Heights, N. J., in 1931. It is now known to be present in Delaware, Maryland, Pennsylvania, Virginia, North Carolina, and South Carolina. In North Carolina it has been found in 15 counties, and in the summer of 1935 it was estimated to have damaged the vetch seed crop in part of this area to the extent of 50 percent. In South Carolina only two counties are yet known to be infested.

This pest lays its eggs on the immature pods, and the grubs burrow into the seed, where they mature. Usually the adults emerge from the seeds shortly after harvest, but individuals are sometimes imprisoned in unopened pods indefinitely, and it is believed that the insect may have been introduced into the United States in this way. The pest is unable to reinfest vetch seed in storage but is dependent upon the growing crop for its perpetuation. Its life history is being carefully studied and is now fairly well known, except the location in which the adults spend the winter.

## ADDITIONAL INSECT VECTORS OF STEWART'S DISEASE

The search for vectors of Stewart's disease of corn, other than the corn flea beetle (*Chaetocnema pulicaria* Melsh.), already known to carry the disease over winter, has been continued during the year. The disease has been cultured from two additional species of beetles, namely, *Chaetocnema denticulata* Ill., a flea beetle already suspected as a vector, and *Stilbus apicalis* Melsh., apparently a pollen feeder on corn.



These cultures were made from individuals collected in the field in Virginia, in April before corn was planted, and the insects apparently had carried the infection over winter.

#### CORN EARWORM

The summer of 1934 was marked by one of the most severe and general outbreaks of the corn earworm ever recorded. From Ohio on the east to Iowa and Nebraska on the west and from Minnesota southward to Arkansas the insect wreaked havoc with the corn crop. In Iowa alone the loss to corn was estimated to have been at least 10 percent of the crop. Other crops, such as tomatoes, were severely injured throughout this region.

For several years limited investigations have been conducted in an effort to obtain practical control of this pest in corn. These studies have been intensified and expanded and a full program has been set up with a view to determining fundamental facts regarding the insect, including the geographic limitation of hibernation. Some 13 observation stations, located from Kansas and Nebraska eastward to the Atlantic coast and as far north as Connecticut, have been established for this purpose. At four of these stations, located in Virginia, Missouri, Indiana, and Kansas, respectively, intensive observations on all phases of the behavior of the insect are being carried on. Included in this program are investigations of resistant strains of corn, control through insecticides, and the utilization of variation in farm practice or cultural control.

#### INSECT PESTS AFFECTING THE MILLING INDUSTRY

During the year it was demonstrated that, contrary to common belief, the eggs and young larvae of the flour beetles pass unharmed through the milling process. This indicates that infested grain and infested clear and low-grade flours fed into the product for blending constitute the most important sources of infestation for flour in the mills.

The relative efficiency of the several standard fumigants used to protect stored grain has been determined. The perfection of a method of applying one of these, viz, hydrocyanic acid gas, to milling equipment has resulted in lower costs for fumigants, increased efficiency, reduced labor charges, reduction in loss of running time, and elimination of loss because of stock ordinarily removed from milling machinery and sold as stock feed.

#### EUROPEAN CORN BORER INSPECTION AND CERTIFICATION

Issuance during the fiscal year of 16,184 certificates for commodities requiring Federal certification to meet the requirements of State quarantines or orders on account of the European corn borer (*Pyrausta nubilalis* Hbn.) was an increase of 55 percent in the number of certificates required in the same territory during the previous fiscal year. Articles covered by these certificates had an estimated value of \$186,391. This sum is 83 percent greater than last year's estimated valuation of certified commodities. With the exception of November 1934, when the number of certificates issued approximated that of the previous year, the monthly certificate requirements uniformly exceeded those of any previous month since reorganization of the Federal corn borer inspection service in January 1933. Stimulated sales of roots and plants of dahlia largely occasioned the demands for this type of inspection and certification.

State European corn borer quarantines or orders necessitating maintenance of a Federal inspection service remained unchanged during the year. Entry of likely carriers of the corn borer from infested States into Arizona, California, Colorado, Georgia, Louisiana, Nevada, Oregon, Texas, and Utah was still conditioned on Federal inspection and certification.

Few of the State quarantine orders were revised or reissued during the year. In a revision effective January 15, 1934, the Nebraska State quarantine was changed to eliminate celery, oat and rye straw, cosmos, zinnia, and hollyhock from the articles under regulation. Restrictions formerly imposed by the Nebraska quarantine on the movement of vegetable and floral plants from Indiana, Michigan, and Ohio were also eliminated. A supplement to Colorado European corn borer quarantine no. 4, effective May 1, 1935, permitted entry into Colorado until July 1, 1935, of cornstalks and fodder when sweetened and processed in hammer mills approved by inspectors of this Bureau. The State of Illinois on May 8, 1935, modified its corn-borer quarantine to permit admission into that State of green sweet corn and corn

on the ear from 28 uninfested counties in the southwestern part of Indiana. A safety zone of uninfested counties is prescribed between these excepted counties and counties which were wholly or partially under restriction prior to revocation of the Federal quarantine in 1932.

An intrastate quarantine approved by the commissioner of agriculture and immigration of Virginia on October 4, 1934, restricts the shipment of certain likely carriers of corn borer infestation from Accomac and Northampton Counties to other parts of the State. Since extensive surveys failed to locate the pest on the mainland of Virginia, the quarantine is enforced to confine the infestation to the Eastern Shore counties. Later, on November 7, 1934, the Virginia interstate quarantine was extended to include Delaware and Maryland among States designated as infested.

On June 3, 1935, the Maine quarantine on account of this insect became effective. This quarantine regulates the shipment of vegetables, plants, and cut flowers of certain types of plants originating in the New England States and shipped into the State of Maine. Shipments from Boston were the principal ones affected by this quarantine. The 1935 regulations parallel those enforced during 1934.

In States infested by the European corn borer and Japanese beetle or gypsy moth, this Federal inspection was rendered by the permanent inspection force. With the Japanese beetle and gypsy moth inspection corps already covering all corn borer infested territory in the Middle Atlantic, New England, and South Atlantic States, there remained but the eastern North Central States in which it was necessary to station inspectors assigned exclusively to corn borer certification. Inspectors in nonoverlapping territory were stationed in Detroit, Mich., Indianapolis, Ind., and Cleveland, Ohio. These three inspectors were continuously occupied by their assignment to part-time transit inspection during the shipping seasons and to Japanese beetle trap supervision in their districts during the shipping inactivity of the summer months. The time they devoted to trapping was compensated for by corn borer certification performed by Japanese beetle inspectors.

Within the Japanese beetle quarantined area demands for corn borer certification on Long Island were sufficient to warrant one inspector devoting his time exclusively to this work. Most of the establishments in this territory were uninfested by the Japanese beetle, so were entitled to beetle certificates in bulk. The volume of shipments from Long Island could not be met by an inspector making daily calls from the district Japanese beetle office in New York City. During the summer months, when shipments of dahlia tubers and other products requiring corn borer certification were at a minimum, the Long Island inspector was transferred to Japanese beetle trap supervision, and such corn borer certification as was necessary was available through the Japanese beetle organization.

Eight additional appointed personnel carried on corn borer funds were not assigned to districts on the basis of predominance of corn borer inspection work but were stationed where joint Japanese beetle and corn borer inspection formed part of the regular routine.

Supplementing routine inspection visits to New Jersey nurseries requiring Federal and State corn borer certification, careful examinations were made from September to November 1934 for corn borer infestation in 54 establishments. All State and a considerable portion of Federal corn borer certification was jointly handled in New Jersey by the regular Japanese beetle inspection force, which was maintained by allotments from these two funds. At the larger establishments from 500 to 1,000 stalks of host plants were examined. On smaller plots all stalks in the vicinity were included in the survey. Premises scouted included representative nurseries in each of the 21 counties in the State. In the northern section of the State only one establishment, in Bergen County, was found to harbor an infestation. Each of six nurseries scouted in Monmouth County was found infested. Dissection of stalks of field and sweet corn grown on or near these premises showed from 8 to 63 infested stalks in 100 stalks examined at each location. Larval population ranged from 1.2 to 2.6 larvae per infested stalk. Nurseries scouted in counties bordering the Delaware River were all found free from infestation. Four out of six nursery premises scouted in Atlantic County evidenced from 28 to 68 percent stalk infestation with a rather uniform average of 1.55 larvae per infested stalk. An additional nursery in Atlantic County and one in Cape May County on further inspection beyond the usual count of 100 stalks showed slight infestations. Information acquired in this survey was used as a basis for the issuance of



certificates to uninfested establishments during the fall of 1934 and until April 15 of the spring of 1935. For the purpose of obtaining infestation data in areas of the State from which oat and rye straw is certified, additional counts and inspections were made in the northern and western sections of the State for possible infestation spread and population increases.

Stubble counts for corn borer infestation were made in the less populous sections of Long Island by the inspector stationed in that district. In thoroughly canvassing the island late in the fall, there were examined 5 fields in each section and 125 stubbles in each field. Observations in connection with the survey showed that many of the farmers in 1934 cut their corn stubble at the ground level in accordance with good corn borer control practice. This was particularly apparent where sandy soil had been well cultivated during the growing season. Not much corn is grown on the eastern end of Long Island, so it was with difficulty that the inspector located cornfields there for counts of infested stubble. Nevertheless borers were quite evident in many fields. The survey extended to 26 localities and included counts in 51 fields, with a total acreage of 307 acres. Infestations found in Nassau County ranged from 2.4 to 52 percent, most of the stubble showing approximately 30-percent infestation. The highest infestation was found in a 4-acre field of sweet corn at Jericho. In Suffolk County negative counts were made at West Islip and Lake Grove, with other points showing infestations ranging from 0.8 to 43.2 percent. Infestation in this county is apparently heavier in the northern section than in the southern townships. At Southampton, the easternmost point to which the survey extended, 2 fields examined showed respective infestations of 15.2 and 21.6 percent. Fields of dahlias examined as a part of the corn borer inspection of dahlia roots disclosed further heavy infestations of the borer. One field in particular at Quogue, on the eastern end of the island, showed an especially heavy stalk infestation. As many as 11 borers were taken from a medium-sized plant.

Degrees of corn borer infestation in heavily infested sections of Connecticut were determined by four scouts employed by the State Agricultural Experiment Station. It was found that the infestation in the State equaled or exceeded that of 1933. Some fields evidenced 100-percent infestation. In the New Haven area inspection of one shipment of beets to comply with the Maine corn borer quarantine disclosed heavy infestation in the tops, resulting in refusal of certification. This condition was reported as rather general in that section of the State. Corn borer destruction of sweet corn was somewhat general throughout the State, causing the growers considerable loss. Prices of roasting ears harvested from infested fields were so low that some farmers plowed under their crop rather than harvest it at a loss. Local sweet corn shipped into the Boston market was more heavily infested with the corn borer than for several years past. A prominent Vermont canning factory appealed to its corn growers to practice corn borer control to insure the quality of their crop. Stalk infestation as high as 50 percent was observed by State nursery inspectors scouting on the Eastern Shore of Virginia. The borer was found generally established in Accomac and Northampton Counties, from the Maryland line south to Cheriton. Completion of a preliminary survey of infested territory in Pennsylvania by entomologists of the State showed that there were fewer borers in the northwestern sections than in 1933. An increased infestation was observed in most of the recently infested counties in the central and east-central sections. Investigations in the oldest and most heavily infested areas, in Erie and Crawford Counties, showed a continued decrease in borer population.

## BLACK STEM RUST QUARANTINE ENFORCEMENT

The quarantine on account of the black stem rust of grains (*Puccinia graminis*) regulates the interstate movement of barberry and *Mahonia* plants, except *Berberis thunbergii*, the Japanese barberry, and its rust-immune varieties. These regulations provide that nurserymen who grow only rust-resistant species, as determined by inspection, may be granted permits for shipping to the grain-growing States of Colorado, Illinois, Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Wyoming. Such action is in support of the campaign waged for several years by the Department and the above States in destroying those barberries that spread the rust. Applications of 23 growers and 1 dealer were approved during the year, authorizing shipments under these regulations. Thirty ship-

ments in apparent violation of the quarantine were intercepted by transit inspectors during the fiscal year and returned to shippers. Of these, 24 were found on investigation to be noncommercial shipments by persons unaware of the regulations.

*Berberis mentorensis* Ames (MS), a new hybrid of *Berberis* covered by Plant Patent No. 99, was added to the list of species determined as resistant to the rust, making a total of 27 species that may be shipped under permit. The Bureau has available for distribution lists showing (1) *B. thunbergii* and its rust-immune horticultural varieties, which may be moved interstate without permit; (2) *Berberis* and *Mahonia* species or varieties sufficiently resistant to black stem rust for shipment into protected States; (3) *Berberis*, *Mahonia*, and *Mahoberberis* species or varieties which are susceptible to attack by black stem rust and which may not be moved into protected States; and (4) species or varieties of *Berberis* or *Mahonia* for which reaction to black stem rust attack has not been determined and which therefore may not be moved to protected States at least until their susceptibility to rust attack has been determined.

Cuttings of *Mahonia* for decorative purposes only, including hollygrape (Oregon grape), were removed from restrictions under a modification of the quarantine which became effective on February 20, 1935. The native species growing in the Northwestern States, and much used for decoration, have been determined as resistant to the disease.

### BARBERRY ERADICATION

Approximately 18,900 square miles of territory in the North Central grain-growing States was surveyed for common barberry bushes during the fiscal year, resulting in the eradication of more than 570,000 bushes on 6,039 different properties. This work was a continuation of the public-works program for the prevention of stem rust undertaken in August 1933. Men employed to conduct the field work were obtained through the local reemployment offices, in accordance with the rules and regulations approved by the Public Works Administration.

#### ORGANIZATION

Fifteen States cooperated with the United States Department of Agriculture in the barberry-eradication program during the fiscal year. The work was conducted as a Federal project, with responsibility for general supervision resting with the Department. Because of the seasonal nature of the work, the permanent field personnel has been restricted almost entirely to a leader in charge and one clerk in each State. During the active field season approximately 120 trained men were employed to supervise the work of laborers obtained through the reemployment offices. During the winter months, when weather conditions prevented field survey, a few trained men were retained to assist with the general informational program.

#### SURVEY AND ERADICATION

Eradication activities were centered in areas where bushes were known to be numerous and where local inexperienced men could be employed effectively. Crews consisting of from 6 to 10 men were supervised by foremen with previous training and experience in eradication procedure. The survey under way on July 1 was continued late into December before weather conditions made further work of this type impracticable. Employing local men has proved effective, particularly in areas where bushes were numerous.

There are parts of Illinois, Minnesota, Wisconsin, Colorado, Iowa, Ohio, Indiana, and Michigan where barberries are plentiful, particularly along rivers and on other rough uncultivated lands. In some instances it was found necessary to survey entire counties intensively in order to establish boundaries of barberry infestations and bring them under control.

On the other hand, in a few of the western States of the area, including the Dakotas, Montana, Wyoming, and Nebraska, the future problem is largely a clean-up, although the few bushes remaining in these important wheat-growing States constitute not only a continuous rust hazard but a source of further spread. The final clean-up of these scattered bushes is an important part of the control program.

Table 15 summarizes (by States) the eradication data for the fiscal year.



TABLE 15.—Progress in barberry eradication by States, fiscal year 1934-35

State	Total properties cleared of bushes	Total barberries destroyed	Territory covered	Men employed	Employment, P. W. A.
	Number	Number	Square miles	Number	Man-hours
Colorado.....	95	23,696	484	48	12,069
Illinois.....	1,033	16,204	4,430	269	48,125
Indiana.....	133	3,037	359	39	12,031
Iowa.....	872	22,717	2,537	205	61,952
Michigan.....	1,182	113,981	622	135	39,750
Minnesota.....	232	4,983	343	76	24,825
Missouri.....	102	3,626	2,860	32	3,938
Montana.....	15	1,216	284	12	4,697
Nebraska.....	40	140	801	93	16,887
North Dakota.....	11	330	557	48	6,218
Ohio.....	1,026	137,009	1,836	118	45,659
South Dakota.....	26	142	434	22	8,171
Wisconsin.....	1,229	60,405	2,987	120	108,402
Wyoming.....	2	7	358	26	5,413
Virginia.....	41	187,863	30	14	1,729
Total.....	6,039	575,356	18,922	1,257	398,867

<sup>1</sup> 40 additional men were given 2,486 man-hours of employment in connection with the barberry-eradication program by the Virginia Emergency Relief Administration.

Common salt was most generally used for eradication during the year. Less than 1 percent of the barberry bushes were found to survive proper treatment with salt. From 10 to 15 pounds is the recommended application for a bush from 4 to 6 feet high. Bushes are dug only where the salt treatment would endanger nearby trees and shrubbery.

Sodium chlorate alone or mixed with sodium chloride proved an effective killing agent when applied as a spray and drench, particularly in connection with eradication of native barberries (*Berberis canadensis*) in southwestern Virginia. A gallon of the solution (containing 2 pounds of chemical) was found sufficient to cover 40 square feet of ground surface. Other chemicals used experimentally have not proved as effective, economical, readily available, and safe to handle as common salt.

#### INFORMATIONAL ACTIVITIES

The various informational activities constituted an important part of the preeradication work during the year and included demonstrations at local, county, and State fairs, news articles in local papers, illustrated talks before rural and urban school groups, and the distribution of illustrated pamphlets, lesson plans, and circular letters.

During the year school children reported a total of 689 properties on which barberries were growing, resulting in the eradication of more than 13,000 bushes. The interests of school children and adults have been encouraged through a carefully organized educational program in each of the States. As a regular part of the field program during the year, brief illustrated talks were given before 5,933 schools in 70 counties. Results of this work by States are shown in table 16.

TABLE 16.—Results of informational work by States, fiscal year 1935

State	Counties covered on school work	Bar-ber-ry loca-tions re-ported	Bar-ber-ries de-stroyed as re-sult of re-ports	People reached through infor-ma-tional activi-ties	State	Counties covered on school work	Bar-ber-ry loca-tions re-ported	Bar-ber-ries de-stroyed as re-sult of re-ports	People reached through infor-ma-tional activi-ties
	Number	Number	Number	Number		Number	Number	Number	Number
Colorado.....	8	4	56	3,835	North Dakota.....	7	2	2	13,488
Illinois.....	6	79	674	15,591	Ohio.....	0	67	2,322	-----
Indiana.....	5	30	108	113,800	South Dakota.....	6	4	13	18,587
Iowa.....	10	175	0	26,855	Wisconsin.....	1	43	394	2,753
Michigan.....	4	189	14,030	86,306	Wyoming.....	5	2	3	5,744
Minnesota.....	2	66	179	10,003	Total.....	70	689	18,140	337,282
Montana.....	8	11	342	25,000					
Nebraska.....	8	17	17	15,320					

<sup>1</sup> This figure represents bushes destroyed on properties actually reported by children. Often the report of 1 bush is indirectly responsible for the eradication of many in the surrounding territory.

## RUST SURVEYS

Except in certain localities in Minnesota and North Dakota, the 1934 losses from stem rust in the spring-wheat area were very slight. During the spring barberries became infected earlier than usual and a considerable number of local epidemics of rust developed near them, but high temperatures, together with the drought, prevented a damaging spread of the fungus, except in those localities where there were frequent dews or showers. The uredinal stage of stem rust of wheat did not survive the winter of 1933-34 as commonly in Texas as in some other years. There was, however, considerable overwintering on oats.

Seven hundred and eighty-two rust specimens collected in 1934 were identified as to the physiologic forms present. The most surprising result of this work was the fact that form 56, heretofore unimportant and not wide-spread, constituted 30 percent of the total number of collections identified, whereas form 34, which also had been relatively rare, constituted 20 percent of the total. A different form was obtained from each three collections from barberry bushes, while a different form was found in each 35 collections of rust obtained from grain plants away from barberries, further indicating that the bushes are an important factor in the persistence of physiologic forms and the production of new ones.

During the winter of 1934-35 the uredinal stage of stem rust of wheat overwintered rather abundantly in Texas but little was found on oats. Because of a large acreage of late wheat in Kansas and Nebraska, rust developed far more abundantly in those States in the spring of 1935 than is usually the case. Frequent rains and favorable temperature contributed to the rapid spread of the fungus. The generally cool, wet weather during May and the first half of June resulted in heavy stands and a succulent growth of grains in the spring-wheat area. The crops were from a week to 10 days, and in some instances 2 weeks late, with other conditions ideal for the development of rust. Strong south winds on June 23 and 24 carried an enormous number of spores from Kansas and Nebraska into the spring-wheat area. On June 23 spores caught on vaselined slides at St. Paul indicated that they were falling at the rate of 1,000 per square foot each in 24 hours. As a result of weather conditions favorable for the spread of the rust, combined with other circumstances described, the most wide-spread epidemic of wheat stem rust in recent years occurred in the summer of 1935.

Although some local rust epidemics developed on rye and other grains near barberry bushes there was relatively little rust on oats and rye away from bushes, further indicating that wind-blown inoculum was the important factor contributing to the extensive damage to wheat this year. Had barberry bushes been numerous in the Dakotas and Minnesota it is evident that oats, rye, and barley would not have escaped serious damage.

## CLASSIFICATION OF BARBERRIES

Approximately 140 different species, varieties, and hybrids of barberries have been obtained from the Arnold Arboretum and nurseries throughout the United States and planted in an experimental plot at Bell, Md. During the fall of 1934 and again in the spring of 1935 tests were continued to determine the rust susceptibility of the individual species. The outdoor test confirmed data obtained heretofore under controlled conditions. In determining the reaction of barberries to the different varieties of stem rust in the greenhouses at St. Paul, a number of rust crosses were made and considerable evidence was obtained that in nature unusual forms may result from such crossing.

During the past year 27 nurseries requesting permits to ship species of barberry other than Japanese were inspected, in keeping with the provisions contained in Quarantine No. 38 (revised). Certificates to the nurseries that qualified were issued by the Division of Domestic Plant Quarantines.

## TRUCK CROP AND GARDEN INSECT INVESTIGATIONS

## WIREWORMS

Investigations on the control of wireworms in the irrigated areas of the West have been continued, the measures tested including soil fumigation with naphthalene, flooding at a period when the air temperatures are high, drying out of the soil, trapping of adults, and crop rotation. The work on the sandy land wireworm in South Carolina has been completed, and these investigations show



that losses from this pest can be reduced by proper fertilization, crop rotation, and early planting. Where an abundance of land is available the noncultivation of land for one season will also aid materially in reducing wireworm populations.

The Gulf wireworm (*Heteroderes laurentii* Guer.) is becoming of greater importance each year in the Gulf region and on the Coastal Plain. This wireworm is likely to be more abundant in land that has been tilled year after year than in untilled land.

#### BEAN AND PEA INSECTS

The Mexican bean beetle continues to be the most important pest of beans in the United States, and while the winter survival for 1934-35 was lower in Ohio than it had been for several years, with favorable spring conditions the beetle populations built up to the point where the insect caused considerable damage. Both field and laboratory tests of many types of insecticides have been conducted in Ohio and Virginia. The work with insecticides showed quite conclusively that derris powder mixed with water and applied as a spray gave exceptionally good control of the bean beetle, both in Ohio and Virginia. Cryolite also was effective. For some unexplained reason, the dosage of magnesium arsenate, that is, 1 pound to 50 gallons of water, which heretofore had been effective in the control of the bean beetle has not yielded the same results during the past few seasons, and it is now necessary to use 2 pounds of magnesium arsenate to 50 gallons of water in order to bring about the same results. This high dosage may result in some injury to the bean foliage.

With the establishment of pea-canning factories in the Northwest, the control of the pea weevil has increased in importance. The utilization of a border trap crop and the plowing under of these border plantings prior to the time that the main plantings blossom have given encouraging results. During the latter part of the year this work was expanded to include studies of the weevil in the Dayton, Wash., area.

The pea aphid again caused heavy losses to the pea growers in Wisconsin, New York, and Ohio. The investigations this season consisted primarily of field-plot tests with several insecticides, and while the results to date are only of a preliminary nature and cannot be used as a basis for recommendations on pea aphid control, the indications are that a derris powder spray may be useful against the pea aphid.

#### BEEF LEAF HOPPER

In the beet-growing area of southern Idaho the early-season indications were that heavy leaf hopper populations could be expected. The early-season prospects were borne out by large numbers of leaf hoppers appearing in the beet fields late in the spring. In California, studies on the migration of the leaf hopper and its desert host plants have been continued. Observations have also been continued on the effect of spraying desert hosts and the elimination of Russian-thistle on leaf hopper populations. The actual operation of these two latter activities was conducted by the sugar companies and the State workers.

An added feature of the leaf hopper work was the outlining of the critical breeding areas of the leaf hopper in southern Idaho. This work had for its objective the possibility of controlling weeds in the abandoned land and desert areas through proper land handling as a means of reducing leaf hopper populations. Evidence accumulated indicates that native grasses which are not hosts of the leaf hopper will replace the introduced weed hosts in the large breeding areas if given an opportunity. Similar studies have been carried on in Utah and Colorado; however, the areas involved here are much larger than in southern Idaho, and consequently the information regarding the critical breeding areas of the leaf hopper in these two States has not been as complete as for southern Idaho.

#### TOBACCO INSECTS

Derris powder has shown excellent promise as a control for the tobacco flea beetle, especially in the seed beds. Similar control has been secured in the field, but the cost of such treatments has not been determined. Barium fluosilicate, heretofore reported as useful in the control of flea beetles in the shade-grown tobacco areas of Quincy, Fla., has not proved satisfactory during the past season, as it may cause considerable injury to the tobacco plant. Cryolite,

while effective against the flea beetle, also under certain conditions produces injury to the tobacco plants.

Many materials have been tested as substitutes for lead arsenate and paris green for the control of the tobacco hornworm, but as yet no promising material has been found.

The work on stored-tobacco pests has been directed primarily to the use of a light trap in warehouses, combined with fumigation. In control tests these measures have effected a very decided reduction in the amount of stored tobacco destroyed by the cigarette beetle and the tobacco moth.

#### BERRY INSECTS

Investigations of berry insects have consisted mainly of a study of the control of the raspberry fruitworm and the red berry mite in the Puyallup Valley of Washington. Control tests have been conducted against the strawberry weevil at Chadbourn, N. C., to develop insecticide treatments and cultural control measures that will avoid the presence of objectionable residues on the berry at harvest time. The strawberry crop on the Coastal Plain develops fruit rather slowly in some seasons and oftentimes it is necessary to treat the crop to prevent damage from the strawberry weevil when there are large green berries on the plant. The use of an arsenical at such a period would leave an objectionable residue on the berry at harvest. The results of these tests were inconclusive.

#### STUDIES OF NONARSENICAL INSECTICIDES

Laboratory experiments and large field-plot tests to determine the relative toxicity of pyrethrum and derris mixtures for the control of several species of cabbage worms have been carried on at several laboratories. The field-plot tests on cabbage have shown definitely that derris dust mixtures containing from 0.5 to 1 percent of rotenone are effective against the common cabbage worm, less effective against the cabbage looper, and still less effective against the diamond-back moth. The indications, nevertheless, are that derris powder will be a useful material in the control of all three species of these cabbage pests. In general pyrethrum dust mixtures were less effective than those of derris against all three species. An outstanding feature of the laboratory toxicity tests is the different action of derris on the insects tested. For example, the celery leaf tier is not affected by derris powder; the semitropical army worm, while repelled by derris, is not otherwise affected; the common cabbage worm, on the other hand, readily succumbs to derris powder.

#### MISCELLANEOUS VEGETABLE INSECTS

Fumigation of sweetpotatoes (to be used for seed purposes) with paradichlorobenzene has yielded some very promising results.

In California the cleaning up of nightshade, the winter host plant of the pepper weevil, has proved to be of value in reducing injury from this pest.

Experiments on the turnip aphid in Louisiana indicate that derris dust may satisfactorily protect the turnip crop from damage.

#### GREENHOUSE AND BULB INSECTS

Tests to determine the value of hot water for the control of mites show that delphinium, gerbera, and cyclamen, as well as vigorous cuttings of certain varieties of chrysanthemum, may be successfully treated without plant injury, and that other varieties will suffer slight to moderate injury but will recover satisfactorily.

Experiments with hot water for the control of the iris thrips show that the Japanese iris may be effectively treated either in the spring or fall, but that fall treatment is preferable.

The Mexican mealybug became an important pest in several greenhouses in the Eastern States and the control work showed that this pest is susceptible to fumigation with hydrocyanic acid gas.

It has been definitely shown that fumigation of gladiolus corms with naphthalene toward the end of the storage period, for the control of the gladiolus thrips, will result in a decided retardation of the growth of the corm and in some instances may prevent germination. The gladiolus thrips has continued as a pest of gladiolus and has been reported from practically the entire United States.



### MUSHROOM INSECTS

In the investigation on mushroom pests special emphasis has been placed on possible use of naphthalene and paradichlorobenzene. Chemists of the Division of Insecticide Investigations have been associated with these studies.

### QUARANTINE ON DOMESTIC NARCISSUS

The narcissus-bulb quarantine was revoked, effective April 1, 1935. This action was taken because attempts at general eradication of the eelworm and the greater bulb fly had not been successful, the pests occurring year after year in most areas where such attempts had been made. Furthermore, both these pests have become established in commercial bulb plantings in many States in addition to those in which they were known to occur in 1926, when the quarantine was established.

The removal of the Federal quarantine left the interested States free to act in placing such restrictions as they deemed advisable. The State of Oregon thereupon issued a quarantine on the entry of narcissus bulbs, with inspection and fumigation requirements similar to those formerly in effect under the Federal quarantine. State officers of Florida, Virginia, Pennsylvania, Michigan, and Texas announced that inspections of narcissus would be made the same as when the Federal requirements were in effect, and Maryland officers announced their intention of continuing inspection of these bulbs as part of the general nursery-inspection program.

For the season of 1934 the State nursery inspectors in 27 States reported to the Bureau the inspection of 235,486,085 narcissus bulbs. Detailed information on the number of plantings and bulbs and the extent of treatment in the individual States is given in Circular B. E. P. Q.-373, issued on April 23, 1935.

From July 1, 1934, to April 1, 1935, 154 violations of the quarantine were intercepted at transit-inspection points.

### COTTON INSECT INVESTIGATIONS

The issuance of information on the distribution and abundance of insects attacking cotton, together with timely advice on methods for their control, was resumed during the year. Reports about cotton insects were included in the Insect Pest Survey Bulletin and in press releases and radio broadcasts along the same general lines followed with insect pests of other crops.

### BOLLWEEVIL

The initial bollweevil infestation in the crop season of 1934 at Tallulah, La., was comparatively high, but the hot, dry weather from June 18 to the end of August held the weevils in check. Experimental plots dusted with calcium arsenate following standard recommendations gave an average increase of only 236 pounds of seed cotton per acre, or 19.5 percent, as compared to 419 pounds, or 45.4 percent, during the previous year.

A large series of field and cage tests were conducted to determine the efficacy of a number of insecticides, mixtures of insecticides, and insecticides diluted with carriers. The tests at Tallulah showed the value of several other materials for bollweevil control, but none was found to be superior to calcium arsenate dust. Mixtures of calcium arsenate and hydrated lime, mixtures of paris green and lime, and a mixture of calcium arsenate and copper arsenite gave good results. These preliminary results suggest that these materials may be useful for regions where it may be desirable to reduce the amount of arsenic used or when other insects, such as the cotton flea hopper and cotton leaf worm, must be controlled along with the bollweevil. Tests with thiodiphenylamine (phenothiazine) and sulphur, and with derris root in inert carriers, indicate that these may have a place among effective nonarsenical poisons. Tests conducted to compare the results from dusting with calcium arsenate early in the morning, at midday, and late in the evening were favorable to the early morning applications; and tests to compare the results of dusting at 4-, 6-, and 8-day intervals were favorable to the 4-day program.

For the third year in succession, in tests at Florence, S. C., a mixture of equal parts of hydrated lime and calcium arsenate was as satisfactory for the control of the bollweevil as calcium arsenate alone when each was used at the rate of about 7 pounds per acre per application. Other mixtures of lime with calcium arsenate and with paris green gave good results.

The fourth annual application of calcium arsenate to the soil, at the rate of 400 pounds per acre, was applied on a plot at Tallulah, making a total of 1,600 pounds applied. The average yield of seed cotton per acre for 1934 from the treated plot was 1,701 pounds and from the untreated check plot, 1,744 pounds, a difference of 43 pounds or 2.5 percent. In 1931 and 1932 the treated plot yielded more than the untreated plot, while in 1933 and 1934 the plot with the calcium arsenate yielded less. These yield records indicate that excessive applications of calcium arsenate do not affect the yield of cotton on the particular type of alluvial sandy loam soil near Tallulah. During 1934 velvetbeans grew normally on the treated plot but soybeans and cowpeas soon died.

That a bollweevil may occasionally live for an entire year was again demonstrated at Tallulah in 1934. One weevil placed in a hibernation cage on November 16, 1933, was last observed 360 days later on November 10, 1934. Another weevil placed in a hibernation cage on November 1, 1933, was observed 377 days later on November 12, 1934. The weevils used in these tests were given special care during the summer of 1934 and were again placed in hibernation cages in the fall. They died during the following winter.

#### PINK BOLLWORM

Extensive releases of the parasites *Exeristes roborator* Fab. and *Microbracon brevicornis* Wesm. indicate they are not adapted to conditions in Texas and Mexico where the pink bollworm occurs. Although these insects readily parasitize the pink bollworm, *E. roborator* emerges too early in the spring and *M. brevicornis* does not survive the winters. Four other species of parasites are now being bred for releasing as follows: *Microbracon kirkpatricki* Walk., received from Egypt where it had been imported from east-central Africa; *Elasmus* sp., introduced from Egypt; *Microbracon mellitor* Say, introduced from Hawaii; and *Chelonus blackburni* Busck, introduced from Hawaii.

Studies are under way to determine the resistance of different varieties of cotton to pink bollworm attack, the characters causing resistance, and the influence of different cultural and climatic factors on these characters. Observations at Tlahualilo, Durango, Mexico, indicate that the pink bollworm has a preference for bolls between the ages of 36 and 41 days from the date of blooming. As the infestation becomes heavier the preference is less marked and bolls of all ages are infested. Studies of pink bollworm damage in the vicinity of Tlahualilo showed that the reduction in yield of seed cotton, the reduction in grade of lint, and the damage to the seed caused a loss to the crop of \$22.97 per acre.

#### COTTON FLEA HOPPER

The results of tests at Port Lavaca, Tex., during two seasons show that the average increase in seed cotton per acre in the plots treated for the cotton flea hopper was 230 pounds with a net profit of \$9.75 in 1933 and 306 pounds with a net profit of \$12.66 in 1934. In a series of 336 cage tests in which 15,566 cotton flea hoppers were used in the summer of 1934 for testing 35 insecticides, the best results were obtained from a mixture of 1 part of paris green with 10 parts of sulphur. The heavy migration of flea hoppers to cotton occurred during the first week of June in 1935, which was approximately 3 weeks later than in 1934. Sticky screens used to catch flea hoppers showed that there is considerable movement of the hoppers in the spring at least 24 feet in the air, and that more are collected on the leeward side of the screen. Ninety-nine and eight-tenths percent of the cotton flea hoppers emerged from croton, the principal overwintering host plant. Other plants from which the other 0.2 percent of the hoppers emerged were cotton bitterweed, cocklebur, and bloodweed. Nine generations of hoppers occurred at Port Lavaca during 1934.

#### APHIDS ATTACKING COTTON ROOTS

Certain aphids attacking roots of cotton kill or seriously injure young plants, particularly along the Atlantic Coastal Plain, and studies have been begun at Florence, S. C., to develop control measures for them, especially *Anuraphis maidi-radici* Forbes, *Triphidaphis phaseoli* Pass., and *Rhopalosiphum* sp. The first species causes serious injury to young cotton in North Carolina, South Carolina, Georgia, and Virginia, while the other two species have been reported only from the Carolinas.



## PINK BOLLWORM CONTROL

The outstanding developments of the year in the pink bollworm situation were the finding of infestation in several additional counties in northern Florida and western Texas, no recurrence of the insect in the original infested areas of Florida and Georgia, and continued progress in the eradication of wild cotton in southern Florida and in the special control program in the Big Bend of Texas.

The new findings involved 7 counties in Florida and 3 in western Texas. The fact that only 20 specimens were found in these 10 counties indicates that the infestations are extremely light. As mentioned in a previous report, the discovery of such light infestations is due to improved methods of inspection, particularly to the use of the gin-trash machine.

### NEW INFESTATION IN FLORIDA

On September 3, 1934, one larva of the pink bollworm was found in gin trash at Bascom in Jackson County. Jackson is the largest cotton-producing county in Florida. Additional gin-trash machines were sent to the area, and practically all trash in the county was inspected during the remainder of the season. As a result, seven additional specimens were taken at Bascom, and on September 26 a specimen was found in trash at Cottondale, also in Jackson County. Nearly 2,000 bushels of trash was inspected in this county; consequently, the finding of only nine specimens indicates that the infestation was very light. The other findings in Florida were in Suwannee, Levy, and Hamilton Counties, near the regulated area, and involved 3 additional counties, Dixie, Lafayette, and Taylor, which had no ginning facilities. Only seven specimens were found, indicating that the infestation is also very light in these counties.

The Federal quarantine was immediately extended to take in the infested areas but, as the season was well advanced, it was impossible to obtain and install the necessary equipment for carrying out all of the regulations. The measures taken to prevent the spread of the insect consisted in sending the seed to designated mills, the compression of lint, the disposal of gin trash, and the clean-up of gins after the close of the season's operations. At the close of the fiscal year the ginners were making plans to install sterilizing equipment so as to carry out the regulations in full during the coming season.

### WILD COTTON IN SOUTHERN FLORIDA

The eradication of wild cotton in southern Florida was begun in 1932 to eliminate a severe pink bollworm infestation and has been continued each successive year. Because of climatic conditions, this work can be carried on only during the fall, winter, and early spring.

Eradication activities were resumed about the first of November, and, owing to a very dry season, especially good progress was made. All of the areas cleaned during previous seasons were again recleaned. During this recleaning intensive scouting was carried on to locate any cotton that had been overlooked, and a number of scattered plants and small colonies were found and removed. At Cape Sable, where most of the wild cotton is now located, a considerable area was cleaned for the first time, and in addition all of the area previously cleaned was covered. Many of the islands and keys in Florida Bay were also cleaned. During the season a first clean-up was made covering 908½ acres, from which 76,920 mature and 58,404 seedling plants were removed. From the area recleaned 6,463 mature, 1,666,621 seedling, and 150,477 sprout plants were removed. This might at first appear to be an unusually large number of mature plants to have been found on areas previously cleaned. As the inspectors had had 2 years' experience with wild cotton, they had naturally become more familiar with the various conditions under which it grows, and during the past year they were able to locate many plants that had been overlooked, as shown by the large number removed. Most of these occurred in the Cape Sable area. Because of the importance of maintaining as great a distance as possible between the cultivated and the wild cotton, the seven most northerly counties along the west coast where wild cotton occurs were gone over after the regular clean-up work was discontinued. This was done to remove the seedlings that had come up and thus prevent their fruiting before work can be resumed next fall. It is very encouraging to note that during

each recleaning a much smaller number of plants is encountered, indicating that progress is being made. A number of locations where wild cotton previously occurred were found to be entirely free of plants this last season.

When the eradication of wild cotton was first begun many plants were found growing in almost solid rock on some of the keys. The removal of these plants without breaking off some of the roots, which would put out sprout plants, appeared to be quite a problem, and some experiments were begun to determine the practicability of destroying wild cotton with poison. Excellent results were obtained, therefore the poisoning method was used throughout the past season. As the poisoning treatment alone is rather expensive, however, it has been used only where the plants were growing in rocky places.

Mention has been made in previous reports of the small experimental plantings of cultivated and wild cotton in the United States Plant Introduction Gardens at Chapman Field. In cooperation with the Bureau of Plant Industry, all fruit from this cotton was removed and inspected. On several different occasions specimens of the pink bollworm were found in this cotton. At the beginning of the fiscal year it was not considered worth while to maintain these plantings any longer for inspection purposes; therefore, the officials of Chapman Field moved all of the valuable plants into a screened house and destroyed the remaining ones.

#### CONTROL PROGRAM IN THE BIG BEND AREA OF TEXAS

The special control program begun in the Big Bend area 2 years ago was continued. This program is for the purpose of reducing the heavy infestation and thereby lessening the danger of the spread of the pest to the main Cotton Belt. The measures consist of thorough clean-up of fields and premises, after picking is completed, delayed planting the following spring, and the use of small plots of cotton to trap the late-emerging moths. In the spring of 1934, 28 trap plots were used, and these were continued until about the first of August, at which time the field cotton had reached approximately the same size and fruiting stage. The blooms were collected daily and worms had been found in all but 3 of the plots; in only 5 of these, however, was the infestation over 1 percent. At the time the plots were discontinued infestation had been found in 13 adjacent fields, and in only 1 field was the infestation over 1 percent. This indicated that the infestation was building up very slowly. No regular gin-trash inspections were made, but during September a few incidental inspections were made as time permitted. On September 10, 6,891 larvae were taken from the trash of 17 bales; on September 17, trash from 10 bales contained 925 worms; on September 23, trash from 17 bales contained 9,363 worms; and on October 8, trash from 12 bales contained 9,862 worms. It will be noted from the foregoing figures that the average number of worms per bale ranged from about 90 to a little over 800. The first cotton from a farm contained about 136 worms per bale in 1933 and 1,160 in 1932. Another farm had an average of about 336 worms from the first cotton in 1933 and 922 in 1932. As the inspections made during the year under discussion were about a month later than those made in 1933 and 1932, no accurate comparisons can be made; it will be noted, however, that the number is much smaller than in 1932. Even though a rather large number of worms was found in the 1934 crop, there was very little, if any, field damage; in fact, for the first time since the pink bollworm became established in the Big Bend the farmers were able to pick cotton from the top crop of bolls.

Field clean-up was begun on October 18, but it was about the first of December before very much headway could be made. This was due to the fact that the top crop of bolls produced cotton, and consequently delayed the completion of picking. The most heavily infested fields had been cleaned before the end of November, and all clean-up was completed on January 12. A total of 3,891 acres was cleaned at an average cost of \$4.12 per acre for labor and equipment. This is an increase in the cost of cleaning over the 2 previous years and is due partly to the fact that cotton began opening much earlier than usual. Consequently, the farmers immediately began picking and gave the fields no further cultivation, with the result that a considerable amount of weeds and grass was produced, making clean-up more difficult. The principal reason for the increase, however, was the fact that it was necessary to pay laborers a higher wage than during the previous two clean-ups. The field clean-up was followed by a house-to-house canvass, and only three lots of seed cotton, totaling 125 pounds, were found. This was all destroyed with the consent of the owners.



Trap plots were used again in the spring of 1935. The cotton was planted in the field, instead of being grown in hotbeds, and later transplanted, as was the case during the two previous seasons. The plots ranged in size from one-fourth to one-half acre. Owing to unfavorable weather, the cotton did not begin growing as fast as was expected, but weather conditions also delayed the field cotton, and the trap cotton began blooming at least a month in advance of the field cotton. Bloom collections were begun on May 20, and within a few days infestation was found in several of the plots. At the end of the fiscal year infestation had been found in all 13 plots, and a much larger number of worms is being found this year than last. This may be owing to a difference in the emergence of moths each year. On the other hand, it may be because the field clean-up was a little later this year, on account of the top crop mentioned above. If so, it indicates very clearly that the earlier the fields can be cleaned each fall the fewer moths there will be the following spring, as worms will have less time to enter the soil for hibernation. The delayed planting date of April 15 was satisfactorily observed. Field cotton in Brewster County has just begun blooming, and a few worms have been found, but the cotton in Presidio County is considerably later, and no blooms have yet been produced.

#### NEW INFESTATION IN TEXAS

The new infestation in Texas involved Andrews and Ector Counties and all but a small part of Midland County. The last is not a new infestation, as this area was previously under regulation, having been released February 28, 1933. The last findings had consisted of 2 specimens in the 1931 crop. On October 18, 1934, a specimen of the pink bollworm was found in trash at Midland. This was followed by additional findings on October 23 and 24. Owing to the lack of ginning facilities, cotton produced in Andrews and Ector Counties is ginned at Midland, hence they were involved in the infestation. On October 24, 1 specimen was found in gin trash at Stanton, in Martin County. An examination of the gin records showed that most of the cotton from which the trash came had been produced in Midland County, with only a few fields from Martin County represented. Intensive inspections were made in these Martin County fields and the gin trash from the remaining cotton was caught separately and inspected without any indication of infestation being found. It seems almost certain, therefore, that the above specimen originated in Midland County, and this information did not seem to warrant including Martin County in the regulated area. Inspections were continued during the remainder of the ginning season without finding any additional specimens. It will thus be seen that, as was the case in other new areas, the infestation in this area is very light.

The three counties mentioned above were again placed under regulation, and the movement of products therefrom was handled accordingly. Inasmuch as the ginners had had previous experience with the regulations, they cooperated whole-heartedly.

#### CHANGE OF INSPECTION METHOD IN REGULATED AREAS

Heretofore gin-trash inspection has been made in each county under regulation to determine whether or not infestation was present, and if so to what degree. In the fall of 1933 green bolls had been collected from a number of lightly infested counties and were later inspected as a check on the laboratory method. It was demonstrated that a rather light infestation could be discovered by this method. Therefore, as an economy measure, a plan was worked out whereby a number of gin-trash crews could be eliminated and at the same time a check on the infestation condition could still be taken, although somewhat delayed. This plan is to collect green bolls in the fall in counties where infestation has existed for some time. The bolls are preserved and inspected later in the season, as regulatory activities decrease. In case no infestation is found in the bolls, gin-trash inspection is to be substituted the following season.

#### SITUATION IN OLDER REGULATED AREAS

Intensive gin-trash inspections were carried on in the older regulated areas of northern Florida and Georgia. In Madison County, Fla., 1 specimen of the pink bollworm was found, but in the other counties of Florida and in the three counties in Georgia the results were all negative. Intensive inspections

were also carried on in the western extension of Texas and in Lea and Roosevelt Counties, N. Mex., brought under regulation last season. In Terry County, Tex., 2 specimens were found, but the results were negative in the remaining counties. Gin-trash inspection indicated that infestation in about the same degree as last year still exists in the Safford Valley of Arizona and in the Pecos Valley of Texas. In the remaining regulated areas the new method of boll inspection has been substituted for gin-trash inspection. The examination of this material is not yet completed; however, infestation has already been established, except in Dona Ana County, N. Mex.

A summary of the various kinds of inspection, together with the number of specimens found, is shown in table 17.

TABLE 17.—*Summary of inspections for the pink bollworm in regulated areas, crop season of 1934*

District	Gin trash		Field		Laboratory	
	Bushels	Pink bollworms	Man-days	Pink bollworms	Samples	Pink bollworms
<b>New areas:</b>						
Jackson County, Fla.....	1,848	9	3	0	0	0
Other seven counties in Florida.....	645	7	0	0	175	0
Midland, Tex.....	761	4	0	0	66	0
Total.....	3,254	20	3	0	241	0
<b>Older regulated areas:</b>						
Pecos Valley, N. Mex.....	941	6	0	0	188	13
Pecos Valley, Tex.....	25	51	0	0	104	0
Big Bend, Tex.....	50	27,041	0	0	23	2,480
Hudspeth County, Tex. (southeastern part).....	2	1,784	0	0	44	232
El Paso Valley, Tex.....	1	14	0	0	234	6
Mesilla Valley, Tex. and N. Mex.....	5	3	0	0	356	0
Tularosa, N. Mex.....	0	0	0	0	0	0
Deming, N. Mex.....	0	0	0	0	0	0
Duncan Valley, Ariz. and N. Mex.....	0	0	0	0	22	0
Safford Valley, Ariz.....	2,378	20	0	0	64	0
Tucson, Ariz.....	370	0	0	0	160	(1)
Northern Florida.....	634	1	20	0	128	0
Southern Georgia.....	3,073	0	0	0	49	0
Western extension, Texas and New Mexico.....	12,354	2	0	0	132	0
Total.....	19,833	28,922	20	0	1,504	2,731
Grand total.....	23,087	28,942	23	0	1,745	2,731

<sup>1</sup> Pink bollworm results negative, but 30 specimens of *Thurberia weevil* found.

#### INSPECTION OUTSIDE REGULATED AREAS

Inspections during the 1934 crop season were for the most part confined to sections immediately adjacent or close to the regulated areas, where infestations would be most likely to occur. As usual, gin-trash inspection began in the lower Rio Grande Valley of Texas, with the machines working northward as the crop advanced. Especially intensive inspections were made in those sections of Alabama and Georgia adjacent to Jackson County, Fla., where a new infestation was discovered; also near the western extension of Texas. Another area in which intensive inspections were carried on was the Salt River Valley of Arizona, which was released from the regulations the latter part of 1933. An invitation was extended by the Mexican Department of Agriculture to make gin-trash inspections in various States adjacent to the border of Texas and also in Baja California, and this was done. On the whole, the supply of trash was plentiful and other working conditions were quite satisfactory. In the Juarez Valley of Mexico, opposite the El Paso Valley of Texas, gin-trash inspections were made by hand from time to time and specimens were found. With this exception, the results of all gin-trash inspection were negative both in the United States and in Mexico. At the close of the ginning season laboratory inspection of green bolls and bollie samples, collected in the various cotton States, was begun. The results of this inspection were



also negative at the close of the fiscal year; however, there is still some material to be inspected.

A summary of the various kinds of inspection and the amount of material inspected is shown in table 18.

TABLE 18.—*Summary of inspections for the pink bollworm outside regulated areas, crop season 1934*<sup>1</sup>

State	Gin trash	Field	Laboratory
	<i>Bushels</i>	<i>Man-days</i>	<i>Samples</i>
Alabama.....	4,860	100	1,140
Arizona.....	5,341	9	30
Florida.....	925	11	0
Georgia.....	5,285	12	161
Louisiana.....	0	0	1,409
Mississippi.....	0	0	330
Oklahoma.....	30	0	454
Texas.....	14,810	58	1,123
Total.....	31,251	190	4,647
Mexico:			
Baja California.....	1,676	0	0
Chihuahua <sup>1</sup> .....	30	0	0
Coahuila.....	228	0	0
Nuevo Leon.....	632	0	0
Tamaulipas.....	452	0	0
Total.....	3,018	0	0
Grand total.....	34,269	190	4,647

<sup>1</sup> All results negative, except that 105 pink bollworms were found in the Juarez Valley of Mexico.

#### CHANGES IN REGULATIONS

During the fiscal year 1935 two changes were made in the pink bollworm quarantine regulations, both of which were for the purpose of including the newly infested sections.

Amendment no. 1, effective September 19, 1934, was made for the purpose of adding Jackson and Suwannee Counties, Fla., to the regulated area.

Amendment no. 2, effective October 31, 1934, was made for the purpose of adding Dixie, Hamilton, Lafayette, Levy, and Taylor Counties, Fla., and Andrews and Ector Counties, and part of Midland County, Tex., to the regulated area.

The above areas were designated as lightly infested. At present the regulated areas include 3 counties in southern Arizona, 14 in north-central Florida, parts of 3 in southern Georgia, 9 in southern New Mexico, and 17 entire counties and parts of 4 additional ones in western Texas. Of this area five counties and part of another in Texas are designated as heavily infested and all of the remaining area as lightly infested.

#### CONTROL AND ERADICATION MEASURES

No changes were made this past season in the measures enforced to control and prevent the spread of the pink bollworm from infested areas. These consisted of (1) disposal of gin trash, (2) sterilization of seed, (3) supervision of oil mills, (4) fumigation, compression, steaming, and roller treating of lint, (5) road stations, and (6) cooperation with Mexico.

#### DISPOSAL OF GIN TRASH

Most gins are equipped with cleaning machinery through which the cotton passes before entering the gin stands. A considerable amount of trash is taken from the cotton by this machinery and many pink bollworms are discharged with the trash, the number depending, of course, on the degree of infestation. The regulations require the daily disposal of this trash by burning, sterilization, or grinding. Several years ago the Texas and New Mexico regulations were amended to require the daily disposal of trash to December 1 of each year, the average killing frost date being prior to this. The ginners have always cooperated by continuing daily disposal of trash until a killing frost occurs, if it is later than December 1.

## SEED STERILIZATION

The sterilization of seed is undoubtedly the most important single measure in controlling and preventing the spread of the pink bollworm. Therefore, gins within the regulated areas are equipped to heat seed to a temperature of 145° F. as a continuous process of ginning. The machinery is equipped with a thermograph so that the temperature of the seed is recorded at all times. During the past season 97 of these machines heated approximately 95,000 tons of seed. Seed heated to a temperature of 145° for 1 hour, and handled so as to prevent contamination, is permitted to move to any destination. This treatment is principally to take care of planting seed, and during the season some 8 or 10 tons of seed were so treated.

## SUPERVISION OF OIL MILLS

The lack of oil mills in some sections of the regulated areas makes it necessary each year to designate outside mills to handle seed from the regulated areas. These mills are equipped with machinery to give the seed a precooking immediately upon arrival. This past season 10 mills were designated, in addition to the 11 located within the area. Approximately 70,000 tons of seed were crushed. Several of the mills were equipped with rollers for treating second-cut and mill-run linters, and 12,285 bales were so treated.

## FUMIGATION, COMPRESSION, STEAMING, AND ROLLER TREATMENT OF LINT

Fumigation is now listed as an optional treatment and, as a result, only three plants were operated during the season. They treated 59 bales of lint and 946 bales of linters. Of the linters treated, 361 bales had been imported from the Juarez Valley of Mexico. At the 12 compresses operating, 133,376 bales of lint and 2,604 bales of linters were treated. A number of gins have roller equipment, and 27,708 bales of lint were treated by this method. A steam-pressure machine was operated by the State of Texas at Presidio and treated 2,083 bales of lint.

## ROAD STATIONS

A road inspection station was again maintained at the junction of the Presidio and Ruidosa roads 1½ miles south of Marfa, Tex. This station is operated to prevent the movement of infested material from the Big Bend area. It was opened September 1, 1934, and closed January 4, 1935, after the field clean-up had practically been completed in the Big Bend. A total of 4,122 cars was inspected, from which 44 confiscations were made. These confiscations consisted of 27 lots of seed cotton, cottonseed, and other materials, 5 pick sacks, and 6 pillows and quilts, all of which were burned, and 7 pick sacks and 1 mattress, which were treated and passed. Of the 44 confiscations made, 6 were found to be infested with the pink bollworm, 45 living and 25 dead worms being found. These worms were in small lots of seed and seed cotton taken mostly from trucks that had been hauling such products. No living worms have ever been found in seed that had been sterilized.

## COOPERATION WITH MEXICO

In the Conchos and Juarez Valleys of Mexico, immediately adjacent to the Big Bend and the El Paso Valley of Texas, respectively, a considerable amount of cotton is produced which is also infested with the pink bollworm. Mexican officials are endeavoring to control the insect with measures similar to those enforced in this country, such as field clean-up, seed sterilization, and supervision of oil mills. In coordinating and carrying out these various measures there is a free interchange of visits by the Mexican officials and inspectors of this project, and a splendid spirit of cooperation has always been maintained.

## THURBERIA WEEVIL CONTROL

Practically all cotton produced in the Thurberia weevil area in Arizona is grown along the Santa Cruz River Valley, extending from Nogales, on the Mexican border, northward about 100 miles, or to 30 miles above Tucson. For the past several years no cotton has been grown in the southern end of the area. This year, however, a little cotton was planted in Santa Cruz County



in the southern end, but the bulk of the crop began about 18 miles above Tucson, extending northward about 12 miles. About 2,000 acres of Pima or long-staple cotton and 5,000 acres of short-staple cotton were grown, and a gin for long-staple and a gin for short-staple cottons were operated. Practically all trash produced was inspected with a gin-trash machine, with negative results. Toward the close of the ginning season field inspections were made of the top crop of bolls, and a light infestation of *Thurberia weevil* was found about 3 miles north of Tubac, in Santa Cruz County, and another at Sahuarita, 18 miles south of Tucson, in Pima County. A supply of bollies was collected, and at the end of the year examination of this material had not quite been completed. A few specimens have been found in material from three additional fields, all located near Tucson. None of the material from the Rillito-Marana district, where the bulk of the crop is grown, has been infested. Only 30 specimens have been found, which, together with the negative gin-trash inspections, indicates that there is a very light infestation in the top crop of bolls.

The measures used in controlling and preventing the spread of the *Thurberia weevil* are the same as for the pink bollworm. These consist of disposal of gin trash, sterilization of seed, compression, fumigation, and roller treatment of lint, and the clean-up of gins, oil mills, etc., at the end of the season. The results of each of these activities are included in the figures given for the pink bollworm.

### BEE CULTURE

Pollination studies on the Pacific coast show that bees shift their activities to fruit varieties in accordance with the sugar concentration of the nectar. Fruit-tree varieties within the same species were found to show wide variation in nectar concentration, resulting in wide variability in the pollenizing effectiveness of bees.

Cooperative studies with the University of California on the cost of honey production indicate that the average cost is 6.9 cents per pound, while the average price received by producers during the year was 4.5 cents per pound. Of 225 California apiaries studied in 1933, 8 percent made a profit, 8 percent broke even, and 84 percent operated at a loss. Similar conditions prevailed in 1934.

Uncontaminated beeswax is known to be white, but white wax required for the manufacture of candles, cold creams, etc., has been difficult to prepare from the crude brown and yellow western beeswaxes. Studies in cooperation with the University of California have shown that brown stains were caused by iron rendering utensils. Wax rendered in glass, aluminum, and stainless steel was white or yellow. The source of yellow pigment was found to be pollen, although some pollens do not impart color to beeswax.

Loco weed (*Astragalus trichopodus*) was found to cause a wide-spread death of adult bees in southern California. It was likewise found that Matilija poppy (*Romneya coulteri*) also affects adult bees. Four other plants, three of which occur in California, are now definitely known to be poisonous to bees.

The difficulty of combating American foulbrood, a contagious disease of bees is further emphasized by the fact that the disease has recurred in the experimental apiary at Somerset, Md., in combs that had been treated with formaldehyde and in which healthy brood had been reared for a period of 5 years. Studies conducted in cooperation with the University of Wyoming in an apiary of 1,700 colonies indicated that honey produced above queen excluders in diseased colonies in practically all cases contains enough spores of American foulbrood to constitute an infectious dose. This fact is contrary to the general belief. On the other hand, out of 58 samples of honey, representing a crop of 220,000 pounds from a commercial apiary in Wyoming having a more or less constant infection of American foulbrood, all showed a spore content less than the minimum infectious dose.

Work is under way to test the resistance of Caucasian, Carniolan, and common black bees to European foulbrood, another contagious disease of bees, and although it is generally conceded that this disease can be readily controlled, an unusually virulent type of this disease has been found in New England. The indications so far are that this particular strain is not amenable to the usual methods of treatment.

Surveys of pollen reserves in commercial apiaries in the Intermountain States bear out the result of previous experimental work that an abundance

of pollen in the hives in the fall is highly beneficial to successful wintering and to the production of strong colonies for the honey flow. Beekeepers have long supposed that too much pollen in the hives in the fall was detrimental. In connection with this work it has been found that individual colonies vary widely as to the quantities of pollen stored in the fall and that localities also differ widely with respect to the availability of pollen.

In cooperation with the Railway Express Agency, a preliminary study of the loss of package bees and queens in transit has been completed. Recommendations relative to methods of shipping and handling bees in transit have been put into effect, with the result that losses are now almost inconsequential, and beekeepers and express agencies have expressed their appreciation of the work of the Bureau in reducing losses.

## INSECTS AFFECTING MAN AND ANIMALS

### SCREW WORM

During 1934 the screw worm fly spread rapidly from the relatively small area in southern Georgia and northern Florida infested in 1933, so that by the close of the summer of 1934 a large number of infestations occurred in the States of Georgia, Florida, Alabama, Mississippi, and Louisiana, and a few in South Carolina. In the West the infestation joined with the area of normal infestation in Texas and other Southwestern States. During the late summer and fall of 1934 the pest had increased to such proportions that its ravages resulted in heavy loss to the farmers and stockmen. As a result of urgent requests for assistance, the sum of \$5,000 was transferred from another appropriation to aid in the direction of a campaign against this pest. The Emergency Relief Administration in each of the States of Mississippi, Georgia, and Florida also provided \$7,500 to carry on educational and control work in these States.

In order to prevent the repetition of the losses suffered in 1934, the act making appropriations for the fiscal year ending June 30, 1936, approved May 17, 1935, provided an immediately available appropriation of \$480,000. Of this sum, \$425,000 is being used to conduct a wide-spread cooperative educational and control campaign in South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and southeastern Texas; and \$55,000 for research work with the hope of developing more effective and cheaper control methods. The primary screw worm fly (*Cochliomyia americana* C. and P.) is probably responsible for 90 percent or more of infestations. It breeds only in living animals and can, so far as known, be controlled by killing the larvae before they reach maturity. The control work aims, therefore, to teach livestock owners methods to prevent exposing their animals to the attack of the fly and how to treat animals that may be infested. To assure that the proper treatment is applied, medicine in sufficient quantities to treat infested animals is furnished free.

On June 30, 1935, 249 men were engaged in this work in 320 counties, and approximately 23,000 gallons of pine-tar oil and 15,000 gallons of benzol had been distributed to these counties.

Studies have been continued on the biologies and habits of both species of screw worm flies and also of related blowflies. Results of investigations of the parasites and predators of the immature stages of the secondary screw worm fly (*Cochliomyia macellaria* Fab.) indicate that artificial propagation of such insects offers a means of reducing screw worm infestations in wildlife.

### HORSE BOTS

Investigations on methods for controlling stomach bots of horses have developed an effective treatment for destroying the infective larvae of *Gasterophilus intestinalis* DeGeer which remain in the eggs attached to the hair of the animal for a considerable period after oviposition has ceased. The method, which consists simply in bathing the infested portion of the host with water at a temperature of 118° F., is particularly valuable in supplementing the carbon disulphide treatment in the fall of the year.

### STABLE FLY

Certain modifications incorporated in the type of trap which operates by the animals walking through it give promise of greatly reducing the annoyance to livestock caused by the stable fly. Preliminary study of the breeding



habits of this fly along the coast of Florida disclosed that prolific breeding takes place in decomposing piles of *Sargassum* sp., a brown marine alga. Destruction of such breeding places would decrease the abundance of the fly.

#### AUSTRALIAN CATTLE TICK

Experiments carried out cooperatively with the Bureau of Animal Industry and the Florida Livestock Sanitation Commission on the Australian cattle tick (*Margaropus annulatus australis* Fuller) confirm the field observations that deer serve as an effective host of this tick. Apparently, however, there is greater individual and seasonal variation as to the number of ticks reared than in the case of the more normal bovine host.

#### BLACK FLIES OR BUFFALO GNATS

An outbreak of black flies (*Simulium* sp.) during the spring of 1935 in Arkansas and Louisiana, especially in the Mississippi Delta area, caused considerable injury and some deaths in livestock. An interesting discovery, and one which may have a definite bearing on finding some method of controlling these injurious insects which have heretofore been more or less immune to control procedure, was made during the winter of 1934. It was found that under laboratory conditions eggs undergo a period of aestivation for as long as 8 months. Under field conditions the eggs are washed into river cut-offs and bayous, where the stagnant water is unfavorable for development. The advent of subsequent floods and the consequent agitation of the water where the eggs have remained dormant produce ideal conditions for the emergence of enormous numbers of the adult gnats.

#### EYE GNATS

Observations on the biology and abundance of eye gnats in the Winter Garden section of southwestern Texas were carried on throughout the year. In June of the current year a representative of the Bureau was sent to assist in the reorganization of the gnat abatement district of Coachella, Calif., where the residents were anxious to continue the control measures recommended by the Bureau.

#### MOSQUITOES

Much assistance has been rendered by the Bureau to various local, State, and Federal agencies in making mosquito surveys, and waging control campaigns in the States of South Carolina, Georgia, Florida, Alabama, Oregon, and Washington.

In the Southeast, mosquito surveys, with recommendations as to suitable control methods, were made at Parris Island, S. C., in cooperation with the United States Marine and the Naval Medical Corps; at Savannah, Ga., and Yorktown, Va., in cooperation with the National Park Service; and at Roanoke Island and adjacent territory on the North Carolina banks. Studies of the salt marshes and salt-marsh mosquitoes of Florida have been carried out during the year, and assistance has been given to county organizations, the State board of health, and the Emergency Relief Administration in mosquito-control problems. In the control of *Aedes aegypti* L., considerable help was given to several towns and cities in Florida which suffered an outbreak of dengue fever.

Mosquito-control activities in the Northwest consisted principally in directing projects in Multnomah County, Oreg., under funds allotted by S. E. R. A. and the city of Portland; and in the Columbia National Forest in cooperation with the Forest Service of the North Pacific region.

Experimental work has been carried out to test the effectiveness of mosquito larvicides and methods for controlling *Mansonia perturbans* Walker and other species in Florida, and *Aedes albopictus* D. and *K. A. vexans* Meig., and the so-called "snow-water" species in the Pacific Northwest.

Investigations have been carried on, in cooperation with the Pathological Division of the Bureau of Animal Industry, on the transmission of the fatal malady of horses known as "equine encephalomyelitis" by mosquitoes. It has been shown in numerous tests that the yellow fever mosquito, *Aedes aegypti*, is an efficient carrier of the western strain of the disease, but a very poor carrier of the eastern strain. The only instance in which the eastern strain was transmitted from an infected to a healthy guinea pig was in the

case of a lot of infected mosquitoes which were fed on the footpads of the healthy guinea pig. The mosquitoes were infected by feeding on diseased guinea pigs at the height of the cerebral period and by feeding on a suspension of the crushed brains of guinea pigs who died of the disease. The disease was transmitted to normal guinea pigs as early as 7 days and as late as 63 days after the infective meal. This indicates that the mosquitoes, after becoming infected, may carry the disease as long as they live.

#### SAND FLIES

Drainage and diking work in controlling salt-marsh sand flies have been continued and extended in Georgia under the partial direction of the Bureau.

#### USE OF BLOWFLY MAGGOTS IN THE TREATMENT OF INFECTED WOUNDS

The objects of this investigation have been (1) to devise a satisfactory method of producing sterile maggots and of having them available throughout the year, so that surgeons could depend upon their hospital laboratories to have a continuous supply at all times; (2) to work out, in cooperation with surgeons, successful means of applying the maggot treatment to human wounds; (3) to investigate how maggots produce their remarkable healing effects.

The first two objectives have now been carried out, and surgeons desiring to use maggots should have no difficulty in getting sterile maggots or in knowing how to use them. Work on the third objective shows that, in addition to removing the diseased tissue, maggots excrete certain substances into the wound, and that one of these substances, called "allantoin", stimulates healing. This material can also be purchased, and during the last 4 months considerable quantities of it have been used with gratifying effects by doctors throughout the United States. Excretions of maggots also contain another substance, not yet identified, which in laboratory tests killed certain disease-causing bacteria in 5 to 15 minutes without injuring human tissues.

#### HOUSEHOLD AND STORED-PRODUCT INSECTS

Considerable assistance has been given to householders, commercial firms, and Federal and local agencies in controlling household and stored-product insect pests. Among other studies conducted during the year, the investigations on insects attacking cottonseed meal in storage, the effect of insect fumigants on paper, and the development of a fumigant for clothes moths are important.

As a result of the purported decrease in the use of cottonseed meal as a fertilizer, larger stocks of this material were kept in storage during the past year. These stocks became heavily infested with the cigarette beetle. The losses caused by this insect were not so much due to damage to the meal itself as to destruction of sacks and the cost of labor involved in resacking. It was found that fumigating with hydrocyanic acid gas at the rate of 1 pound of sodium cyanide to 1,000 cubic feet of storage space, followed by a second treatment 1 month later, using one-half the amount of cyanide, gave satisfactory control.

In cooperation with the Bureau of Standards, tests were made to determine the effect of fumigants on representative samples of documents which were to be placed in the new Federal Archives Building.

Tests conducted during the year suggest that hydrogenated naphthalene (tetrahydronaphthalene) is a promising fumigant against clothes moths. Experiments with this material, conducted under conditions which approached those actually found in the home, indicated that it is more effective as a fumigant against the webbing clothes moth than a mixture containing 75 percent of ethylene dichloride and 25 percent of carbon tetrachloride.

#### IDENTIFICATION AND CLASSIFICATION OF INSECTS

The number of insects received for identification has increased even over the large number submitted in the previous fiscal year. Specialists have devoted practically their entire time to the identification of this material but have been unable to meet the increasing demands of this service. In the attempt to name the specimens submitted for identification, investigations started on the classification of several groups of insects were further restricted and only a few studies of this nature have been completed and submitted for publication.



## FOREIGN PARASITE INTRODUCTION

During the year special effort has been made to eliminate living host material from the shipments of natural enemies forwarded to the United States. This was largely accomplished in dealing with the parasites of the oriental fruit moth, the Japanese and Asiatic beetles, the pink bollworm, and the hessian fly. In these cases the results were highly satisfactory, and it is planned to extend this method to other activities.

The principal hosts of the parasites imported and the countries in which the material was obtained were:

Insect hosts of the parasites:	Countries in which the material was collected
Oriental fruit moth-----	Japan, Chosen.
Japanese and Asiatic beetles-----	Do.
European corn borer-----	Italy.
Pink bollworm-----	Egypt.
Alfalfa weevil-----	France, Italy.
Hessian fly-----	France.
Pine shoot moth-----	Austria.
Larch case bearer-----	Do.
Birch leaf miner-----	Do.
Elm leaf beetle-----	France, Italy.

## ORIENTAL FRUIT MOTH PARASITES

A total of approximately 25,000 cocoons and 5,000 adults were forwarded during the year. Twelve species of parasites were secured from this material for liberation; the most abundant of these were *Dioctes molestae* Uch., *Phaogenes nigridens* Wesm., and *Macrocentrus thoracicus* (Nees). The success attending shipments of adults is illustrated in the case of a consignment of 4,096 *Phaogenes nigridens* females forwarded in cool storage via Panama. This shipment reached the laboratory at Moorestown, N. J., 5 weeks later with less than 1 percent mortality.

## JAPANESE AND ASIATIC BEETLES

The importation of parasites of these beetles from Japan and Chosen has continued on a small scale. Shipments were made of *Tiphia popillivora* Roh., a larval parasite of the Japanese beetle, *Tiphia* sp. no. 29, parasitic upon the Asiatic garden beetle, and *Tiphia* sp. no. 6-b, parasitic upon the latter host and the imported serica. All of these were shipped in the adult stage.

## EUROPEAN CORN BORER PARASITES

What is expected to be the last bulk shipment of corn borer larvae from Europe was collected in northern Italy in November and December 1934 and forwarded to the United States in January 1935. This comprised a total of 1,113,000 field-collected larvae and was estimated to contain 17,000 *Inareolata punctoria* Roman, 167,000 *Lydella grisescens* R. D., and 4,730 *Eulimneria alkae* E. and S. All of these are larval parasites already established in the United States and are to be used in extending the area of colonization.

## PINK BOLLWORM PARASITES

Investigations of the parasites of this pest of cotton were started in Egypt in October 1934. Colonies of adult parasites of several species for rearing purposes were secured through the courtesy of the Egyptian Ministry of Agriculture. Shipments were made of *Microbracon kirkpatricki* Walk., a promising parasite originating in east Africa, *Exeristes roborator* (Fab.), and *Elasmus* sp. All of these arrived in excellent condition and are now being reared in quantity at the laboratory of the Division of Cotton Insect Investigations at Presido, Tex.

## ALFALFA WEEVIL PARASITES

Small shipments of alfalfa weevil parasites have been forwarded from France and Italy. A total of 1,726 adults of the egg parasite *Peridesmia phyttonomi* Gahan were forwarded to the California Agricultural Experiment Station dur-

ing February and March for colonization in that State. Small consignments of *Bathyplectes corvina* Thoms. and *Tetrastichus incertus* Foerst., both of which are larval parasites, have also been made.

#### HESSIAN FLY PARASITES

Small shipments of *Platygaster pleuron* Walk. and *Trichacis remulus* Walk. were made during the spring of 1935. Both of these are minor parasites of the hessian fly in Europe.

#### EUROPEAN PINE SHOOT MOTH PARASITES

Bulk collections of shoots infested with the pine shoot moth were made in Austria during May and June, and these were forwarded to the United States for rearing out the parasites. Examination of samples indicates that this material contains sufficient numbers of nine species of parasites for colonization. The most important of these are *Copidosoma geniculatum* Dal., *Lypha dubia* Fall., and *Tetrastichus turionum* Htg.

#### LARCH CASE BEARER PARASITES

During March a total of 200,000 hibernating cases were collected in Austria and forwarded to the United States. Representative samples revealed a parasitization of 44 percent. The greater portion of these were *Chrysocharis larinicellae* Ratz.

#### BIRCH LEAF MINER PARASITES

Field collection of leaf mines of the birch leaf miner was conducted in September 1934 in Austria, and a total of 32,000 of these shipped to the United States. The dominant parasites were *Phanomeris phyllotomae* Mues. and several species of Chalcidoidea. Three thousand immature stages of the former and 11,300 of the latter were forwarded, in addition to the quantity of host cells mentioned.

#### ELM LEAF BEETLE PARASITES

Insectary tests indicate that *Tetrastichus xanthomelaenae* Marchal, the egg parasite of the elm leaf beetle, passes the winter in the adult stage, and this may explain the difficulty of securing establishment in the United States. Several shipments of reared and field-collected material were forwarded during May and June. Field parasitization in southern France attained a maximum of 53 percent in 1935. Eight thousand hibernating elm leaf beetles were forwarded to the United States in March, and dissections of samples indicated a parasitization of 9.5 percent by the tachinid fly *Anachaetopsis nitidula* (Rond.). This parasite attacks both the adult beetle and the larva.

#### COOPERATION WITH FOREIGN ORGANIZATIONS

Informal cooperative work has been conducted during the year with a number of foreign organizations. The Canadian Department of Agriculture arranged for the collection of 250,000 corn borer larvae in Japan, and assistance was given by this Bureau in assembling the material and in rearing out the parasites at the Moorestown laboratory. A shipment of 48,000 cocoons of the larch sawfly collected in Japan by this division, with funds provided by the Canadian Department, was forwarded to Canada in December 1934. These were heavily parasitized by an undetermined tachinid fly.

In early June 1935 the Canadian Department of Agriculture forwarded two shipments comprising 11,000 adults of *Collyria calcitrator* Grav. for colonization in the sections of Ohio and Pennsylvania infested with the black grain-stem sawfly.

Shipments of parasites have been forwarded during the year to the countries listed in table 19.



TABLE 19.—*Shipments of parasites to foreign countries during the fiscal year*

Country	Host	Parasites
Egypt.....	Mediterranean fruit fly.....	<i>Opius humilis</i> Silv.
Do.....	do.....	<i>Diachasma tryoni</i> Cam.
Do.....	do.....	<i>Tetrastichus giffardianus</i> Silv.
Do.....	Pink bollworm.....	<i>Microbracon mellitor</i> Say.
Italy.....	Oriental fruit moth.....	<i>Glypta rufiscutellaris</i> Cress.
Do.....	do.....	<i>Macrocentrus delicatus</i> Cress.
Fiji.....	Mediterranean fruit fly.....	<i>Opius humilis</i> Silv.
Do.....	do.....	<i>Diachasma tryoni</i> Cam.
Do.....	do.....	<i>Tetrastichus giffardianus</i> Silv.
Poland.....	White grubs.....	<i>Elis</i> spp.
Do.....	do.....	<i>Tiphia</i> spp.
Mexico.....	Pink bollworm.....	<i>Ezeristes roborator</i> (Fab.)
Do.....	do.....	<i>Microbracon brevicornis</i> Westm.

## CONTROL INVESTIGATIONS

### TESTS OF HOUSEHOLD INSECTICIDES AGAINST HOUSE FLIES

The testing of various household insecticides against house flies by the method of Peet and Grady and by a turntable method, which was devised in the Division of Control Investigations, was carried on in cooperation with various insecticide manufacturers. The object of these studies is to improve the methods of testing so that satisfactory specifications for fly sprays can be written. One of the requirements is the adoption of a standard insecticide with which unknown samples may be compared. Phenothioxin was found to have some promise as a standard.

### SURVEY OF THE INSECTICIDAL VALUE OF DOMESTIC SPECIES OF ROTENONE-BEARING PLANTS

In cooperation with the Division of Drug and Related Plants of the Bureau of Plant Industry, the insecticidal action of extracts of some 300 samples of roots of *Cracca*, chiefly *C. virginiana*, collected in 18 different States, was tested against house flies. The most effective roots were found in eastern Texas, southwestern Georgia, and Florida. The plants found north of Georgia possessed very little toxicity. The sample most toxic to house flies was collected in Harrison County, Tex., and contained 1.8 percent of rotenone. The demonstration of correlation between the Durham qualitative color test for rotenone and the effectiveness of the extracts of *Cracca* has facilitated the search for plants of high toxicity and the selection of plants for cultural experiments.

### INSECTICIDAL EFFECT OF ALCOHOLIC EXTRACTS OF PYRETHRUM

In cooperation with the Food and Drug Administration, tests of the insecticidal action of samples of extracts of pyrethrum were made to find which of the three methods of chemical analysis for pyrethrins was best correlated with the insecticidal properties. Tests were also made on the insecticidal effect of mixtures of alcoholic solutions of pyrethrins and rotenone.

### TESTS OF ORGANIC COMPOUNDS AGAINST MOSQUITO LARVAE

Some 200 synthetic organic compounds, made or obtained by the Division of Insecticide Investigations, were tested during the fiscal year against mosquito larvae. In addition to phenothiazine, which was more toxic than rotenone to culicine mosquito larvae, 14 other compounds were found that compared favorably with rotenone in toxicity. Organic compounds of iodine were found to be more toxic than organic fluorine compounds.

### GELATINE-FILM METHOD FOR TESTING INSECTICIDES

A method applicable to testing the effect of light on the toxicity of various types of insecticides by imbedding them in a thin film of gelatine was worked out during the past year. When cabbage worms were fed gelatine film containing derris, in cabbage-leaf sandwiches, they were killed. Pyrethrum powder fed in the same way did not kill them. On the other hand, the cabbage worms

were poisoned by crawling over pyrethrum-impregnated films and were not affected when they crawled over films impregnated with derris. Pyrethrum in this case acted as a contact insecticide while the derris powder did not.

#### THE EFFECT OF LOW TEMPERATURES ON LARVAE OF THE CIGARETTE BEETLE

As a preliminary step toward investigating the possibility of eliminating infestations of the cigarette beetle in tobacco by holding it in commercial cold storages, experiments were made to determine the temperatures necessary to kill uncovered larvae of the cigarette beetle. The results showed that freezing temperatures were not necessary for the destruction of the larvae if the period of exposure were of sufficient length.

#### RELATIVE TOXICITY OF ARSENATES OF CALCIUM

Experimental work has shown that there may be a wide variation in the toxicity of calcium arsenates containing the same amounts of calcium oxide and arsenic pentoxide. Tests with silkworm larvae have shown that calcium arsenates containing water of crystallization were much more toxic than analogous anhydrous compounds. Certain anhydrous compounds failed to kill at the highest dosages taken by the larvae, while the analogous hydrated compounds were very toxic.

#### ATMOSPHERIC FUMIGATION OF BALED COTTON

The experimental work in fumigation of baled cotton at atmospheric pressure was completed within the fiscal year.

#### STERILIZATION OF GRAPES FROM SPAIN

Grapes imported from Spain were treated in commercial quantities in cold storages in New York and Boston for possible infestation with the Mediterranean fruit fly. The method of applying the treatment and the supervision of its application during the first part of the season were a part of the work of the Division of Control Investigations.

#### STERILIZING RICE STRAW BY HEAT

A method of sterilizing imported rice straw was worked out which consists in placing the bales of straw in a vacuum chamber, reducing the pressure, and then applying steam at 10 pounds above atmospheric pressure and holding it for 2 hours. This treatment can be applied to bales of rice straw which do not exceed 30 pounds per cubic foot in density.

#### FUMIGATION OF VETCH SEED

Tests were made to determine (1) the concentration of two fumigants, hydrocyanic acid and carbon disulphide, that could be applied to vetch seed without danger of injury, and (2) the concentration necessary to kill the various stages of the weevil *Bruchus brachialis* Fahr. which might be contained therein.

#### MISCELLANEOUS CONSTRUCTION AND TESTING

Considerable work was done in testing car-fumigation houses along the Mexican border to determine whether the improvements made within the past year would make it possible to reduce either the dosage of hydrocyanic acid used in fumigation or the period of exposure.

#### INSECTICIDE INVESTIGATIONS

During the fiscal year chemists working under the direction of the Insecticide Division were assigned to the following field laboratories: Manhattan, Kans., to assist in the fumigation work carried on by the Division of Cereal and Forage Insect Investigations; Vincennes, Ind., to assist in the study of codling moth control conducted there by the Division of Fruit Insect Investigations; and Takoma Park, Md., to assist with closely related work of entomologists of the Division of Control Investigations. The insecticide laboratory at Wenatchee, Wash., was transferred in February 1935 to Yakima, Wash., in



the interest of better cooperation with the Yakima laboratory of the Division of Fruit Insect Investigations.

Search among plant materials for new insecticidal compounds was continued. Perhaps the outstanding result was the finding of anabasine in the leaves and roots of the tree tobacco (*Nicotiana glauca*) of the Southwestern States. Anabasine is an alkaloid, very similar to nicotine in its physical, chemical, and insecticidal properties, which was first prepared synthetically in the Division of Insecticide Investigations several years ago, and which was later found in a Russian weed, namely, *Anabasis aphylla*.

Many plant samples reputed to possess insecticidal properties were received from various tropical countries, and 12 of them, namely, "*Casearia timuo*", *Cassia chamaecrista*, *Croton capitatus*, *Helenium autumnale*, *H. tenuifolium*, *Ichthyomethia* sp. (bark), *Jacquinia keyensis*, *Lonchocarpus capassa*, *L. monospermus*, *Machura pomifera*, *Piscidia communis*, and *Pterocarpus angolensis*, were put through an exhaustive chemical examination, without, however, the finding of any particularly promising compounds. Derris and cube continue to hold front rank as organic insecticidal materials, and the study of them was continued. Considerable progress was made in the attempt to correlate the toxicity of particular samples with various chemical determinations, which it is hoped will lead to the possibility of evaluating such materials in the chemical laboratory without recourse to laborious biological testing. A critical study of the methods of determining rotenone was also carried out, which unearthed certain errors in the previously used procedure and led to the development of a more satisfactory method. *Crocea virginiana*, or devil's shoestring, continued to be the only American plant in which rotenone has been found. During the year an exhaustive study was made of several hundred samples. Of these samples, 330 were collected by the Bureau of Plant Industry in its survey of the occurrence of this plant over the United States, and the results show that the best samples come from Georgia, Florida, and Texas. Two samples were found that contained 1.8 percent of rotenone; many contained only traces or none at all.

Considerable attention was devoted to nicotine, including a search for insoluble nicotine compounds. One promising new material of this class was developed. This product, called nicotine-peat, is the result of the combination of nicotine with powdered peat. Some peats when used in their natural state hold as much as 9.9 percent of nicotine in relatively insoluble form, and after simple acid treatment some others can hold as much as 13.7 percent. A second material, a solid soluble by-product of the other, known as nicotine humate, was developed at the same time, and may find a place as a substitute for the more volatile nicotine sulphate. It contains about 33 percent of nicotine.

The study of pyrethrum as an insecticide was renewed, and some important forward steps were made. A method was developed for preparing one of the two active principles, namely, pyrethrin II, in a high state of purity by a method much more simple and much less drastic than any previously used. Considerable progress was also made toward a similar separation of pyrethrin I. As a result of these studies it will be possible to test the toxicity of the two compounds separately and determine their relative insecticidal value. A new and much simpler method of determining pyrethrin II was developed which will facilitate not only research studies on pyrethrum but control work in analytical laboratories as well.

Of the synthetic organic chemicals made in the laboratory, only two compounds, namely, phenothiazine and phenothioxin, seem to merit particular attention. Phenothiazine, an organic sulphur compound, with the formula  $C_{12}H_9NS$ , was given a field trial against the codling moth in the summer of 1934. The crude material then available commercially was only about 50 percent pure and very dark colored, and the rather poor results obtained are perhaps to be attributed to these facts. A new method of preparing the product was developed by which it is easy to prepare a pure, light-colored product. At the suggestion and under the guidance of the Division of Insecticide Investigations a large commercial concern undertook production of phenothiazine by the new method, and large batches of excellent material became available to the bureau for testing in the spring of 1935. Many substituted derivatives of phenothiazine were prepared, but all proved less toxic and hence of little interest. Effort was also made to develop pyridine derivatives, similar to the phenothiazine derivatives, but nothing promising was obtained. The other compound that in preliminary tests showed marked toxicity to codling moth was phenothioxin. Methods of preparing both a crude, oily material containing

a large proportion of this compound, and the pure substance itself, were worked out, but no large batches were made. The toxicity of this compound apparently disappears rather rapidly after application to foliage, perhaps because of volatility.

Fundamental studies of the characteristics of oil emulsions, to develop specifications for the preparation and mode of application of the best possible insecticidal preparations of this nature, have been continued at the laboratory at Wooster, Ohio. Particular attention was paid to the development of means of estimating oil deposits, as insecticidal efficacy is primarily dependent upon the quantity of oil that adheres to the foliage of a sprayed plant. In previous years it was found possible to recover and measure highly refined mineral-oil deposits, but the method is tedious, and it fails with vegetable oils; so attention was turned to laboratory methods, and in some cases it was found possible to predict the oil deposits on chrysanthemum foliage by means of experiments made with paraffined plates. Studies have also been made to find other insecticidal materials which, when added to oil emulsions, would dissolve in the oil phase and enhance its insecticidal or ovicidal effect, particular attention being directed to oil-soluble combinations of nicotine. Two promising types of materials were found, namely, a combination of nicotine with beta-naphthol and the nicotine salts of the halogenated fatty acids.

At Manhattan, Kans., a study was begun of several problems connected with the fumigation of flour mills and flour products. Determinations of the concentration of hydrocyanic acid gas in typical fumigations were made, and the superiority of fumigating the milling machinery rather than the mill as a whole was demonstrated. The importance of maintaining a high vacuum in connection with vacuum fumigation of flour products was demonstrated. The great effect the load of flour has in absorbing the hydrocyanic acid, hence requiring larger dosages than the size of the chamber would seem to indicate, was shown.

In connection with experiments conducted in cooperation with the Bureau of Plant Industry to determine the effect of washing on the removal of spray residues on apples, numerous analyses were required, many being made in replicate to furnish data for statistical study of variations. Two special studies of the variation to be expected among the apples in a sample were made, 100 individual apples from an unwashed lot being run at Washington, D. C., and 100 groups of 2 apples from a washed lot being run at Wenatchee, Wash. The former lot showed an extreme variation from 0.073 to 0.214 around a mean of 0.140 grain per pound, and the latter lot a range from 0.006 to 0.050 around a mean of 0.028.

Considerable work was done on the determination of spray residues of rotenone and nicotine deposited by sprays containing derris, cube, and various nicotine mixtures. The red colorimetric test for rotenone previously developed proved fairly suitable for following the loss of derris deposit after spraying, and the nicotine could also be determined satisfactorily.

A study was made of the lead and arsenic content of 11 chewing tobaccos and 7 snuffs, requiring the development of satisfactory methods of analysis. In the samples analyzed, the lead content of the chewing tobaccos ranged from 0.025 to 0.610 grain per pound, and of the snuffs from 0.088 to 0.935 grain per pound. The arsenic content proved in some cases to be higher than was expected on the basis that lead arsenate had been used, but this may have been due to the additional use of other arsenicals.

A new line of work was undertaken in the form of an investigation of accessory materials used to improve the stability or ease of application of insecticides. Stress was laid upon the study of wetting and spreading agents. At the College Park, Md., station a study of the sulphated higher alcohols, which have recently come into prominence as suggested aids in the removal of spray residue from fruit, was undertaken, and it was found that, whereas they do not break down immediately in acid solutions as the soaps do, they do undergo hydrolysis and hence should be freshly prepared. At Washington, D. C., a physicochemical study of wetting and spreading power was begun, making use of measurements of surface tension and interfacial tension against a standard petroleum oil. Detailed studies were made of some soap solutions, from which the great dependence of wetting power on concentration and on the ratio of alkali to fatty acid is easily seen. Numerous commercial wetting agents have been studied, and the claims for some of them shown to be extravagant. In the course of this work two qualitative methods of visually demonstrating moderate differences in wetting and spreading power were de-



veloped, depending on the displacement, by the solution being studied, of a film of oil spread on a glass plate or a celluloid surface, respectively.

The study of the relative toxicity of insecticidal materials to goldfish, which has as its object the discovery of possible relationships between toxicity and chemical constitution upon which future synthetic work can be based, was continued throughout the year. The principal experimental study involved the determination of the relationship between the optically active and optically inactive isomers of dihydrodeguelin. It was found that the optically active compound is approximately twice as toxic as the inactive compound. This fact has an important bearing on the question of the toxicity of derris, cube, and other rotenone-bearing roots, for it is now believed that the deguelin they contain is optically active, and hence it may be appreciably more toxic than the inactive variety on which all toxicological results have been based so far.

A rather extensive investigation of calcium arsenate was undertaken. The dependence of the insecticidal and phytocidal properties of calcium arsenate on its mode of preparation and finished chemical constitution is not well understood. The work during the year confirmed the existence of a previously suggested definite basic arsenate which can be called tetracalcium arsenate. A phase-rule study of the whole system (lime, arsenic acid, and water) was also started in the hope that the higher temperature adopted, 62° C. (143.5° F.), will result in attainment of equilibrium, a goal that was not reached in a similar study conducted several years ago at 35° C. (95° F.).

A few examples of the miscellaneous analytical and investigational work done to aid in various activities of the Bureau indicate the scope or volume of these activities. One hundred and ten samples of miscellaneous insecticidal materials, such as calcium arsenate, spray oils, and fluorine compounds, were analyzed to check on their suitability for experimental use; 70 samples of derris, cube, and other rotenone-containing powders were examined; numerous chemical reagents were tested for arsenic for the Bureau of Chemistry and Soils, etc. Analyses were made of 380 samples of pine wood to which insecticidal materials had been applied. Of these samples, 199 were from trees injected with sodium arsenite, 36 from trees receiving copper sulphate, 96 from trees to which mercuric chloride had been applied, and 49 from trees that received sodium fluoride. These determinations required the development of special methods of analysis, since the resins in the wood interfered with the application of the methods ordinarily used for insecticidal elements in organic materials.

A search was made through the 737,560 United States patents issued during the 17-year period from 1917 to 1933, inclusive, and 47 mimeographed lists containing the numbers and brief abstracts of those relating to insect-destroying devices, insecticide sprayers and dusters, fruit washers, and washing procedures, etc., were issued.

## TRANSIT INSPECTION

Transit inspection was inaugurated at a few strategic railway terminals in 1920 for the specific purpose of enforcing the white pine blister rust quarantine in effect at that time. The value of checking mail, express, and freight shipments of restricted plants in interstate movement, and turning back those moving to uninfested regions, was immediately recognized, and the work has been expanded from year to year to cover other railway centers and to include enforcement of all Federal domestic plant quarantines. The effectiveness of such inspection is shown by the gradual reduction in the percentage of violations found. There were 11.9 violations per 1,000 shipments inspected in 1920 in the enforcement of 1 quarantine, and only 0.6 violation per 1,000 shipments inspected in 1934 in the enforcement of 11 quarantines.

Of special interest in the work of the fiscal year 1935 was the finding of 56 live Japanese beetles at Chicago on July 11 and 12 in a refrigerator car of beans arriving from New Jersey. The car had been partially unloaded, and careful inspection was immediately made of all hampers available at commission-merchant houses. Intensive inspection of produce arriving from the infested areas was continued throughout the summer by inspectors of the Japanese beetle and transit inspection projects, and 88 live beetles and 157 dead ones were taken from 97 of the 314 cars inspected during the season. Bean cars contained the largest number of beetles. Railway agencies were required to fumigate or thoroughly clean such infested cars under the supervision of an inspector.

White pine blister rust infection was found on a white pine being shipped to an uninfected State. It is altogether probable that other shipments intercepted in transit inspection carried injurious plant pests under quarantine. A thorough examination of plants and soil in such shipments would doubtless furnish interesting and valuable information as to the presence of pests, but the time of transit inspectors can be employed more profitably in determining whether the numerous shipments passing through the terminals during the day had been inspected and certified at origin in compliance with quarantine regulations.

Many of the important stations where transit inspection is carried on are inadequately manned, and a few strategic points through which freight, express, and parcel-post shipments are consigned to extensive and important agricultural areas are totally without inspection because of the small amount of funds appropriated for this project.

Active cooperation is rendered by several of the States in which transit inspection is conducted. The State inspectors engaged in the work are appointed collaborators of the Department. The adequate enforcement of Federal plant quarantine regulations is vital to State protection and such cooperation should be extended to other points now worked only by Federal inspectors. In such cooperative work, the transit inspectors report to the State authorities shipments of nursery stock moving without State nursery inspection certificates or with invalid or expired certificates, although such shipments are not intercepted and returned because of the absence of statutory authority. As the direct result of several years of this work, a continued decrease is noted in the number of noncertified shipments moving through transit-inspection points.

In tables 20 and 21 it will be noted that during the fiscal year 1935, 894,395 shipments were inspected for quarantine compliance at 25 points and that 1,749 were found moving in apparent violation of Federal quarantine regulations. The tables include not only stations where Federal inspection is maintained, but also stations worked cooperatively with the States, and with other projects of the Bureau. Year-round inspection with a full-time force was carried on only at Boston, Chicago, Jacksonville, New York, Philadelphia, and Washington, D. C. Inspection during nursery-stock shipping seasons was maintained at Kansas City, Omaha, St. Paul, Portland, Oreg., Seattle, and Spokane. The Pittsburgh work did not begin until May 1. Other points in the table represent either part-time cooperative inspection or places where only a few days' work was done to determine the status of a city as a transit-inspection point.

TABLE 20.—*Summary of shipments of nursery stock and other plants and plant products inspected in transit during the fiscal year 1935*

Station	Shipments	Carloads	Station	Shipments	Carloads
	Number	Number		Number	Number
Atlanta.....	4,228	-----	New York.....	137,054	224
Boston.....	42,185	-----	Omaha and Council Bluffs.....	33,424	12
Chicago.....	102,480	208	Philadelphia.....	282,869	373
Cincinnati.....	57	-----	Pittsburgh.....	78,289	1
Cleveland.....	10,253	47	Portland, Oreg.....	22,724	27
Dallas.....	494	-----	St. Louis.....	334	-----
Detroit.....	10,542	83	St. Paul and Minneapolis.....	37,175	-----
Fort Worth.....	14,592	-----	Seattle.....	16,324	-----
Indianapolis.....	10,497	-----	Spokane.....	12,923	-----
Jacksonville.....	37,487	1 267,085	Washington.....	10,046	6
Kansas City.....	39,354	-----			
Memphis.....	652	-----			
Milwaukee.....	805	-----			
			Total.....	2 894,395	268,066

<sup>1</sup> Waybill information.

<sup>2</sup> Of the above shipments, 597,340 were consigned by parcel post; 256,230 by express; and 40,825 by freight.



TABLE 21.—Shipments of nursery stock and other articles intercepted in violation of Federal plant quarantines<sup>1</sup> at transit-inspection points, fiscal year 1935

Station	Shipments intercepted in apparent violation of quarantine—									
	No. 38	No. 45	No. 48	No. 52	No. 53	No. 62	No. 63	No. 64	No. 71	Total
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
Atlanta.....			5					2		7
Boston.....		154	102		3	1	2			262
Chicago.....	14	41	200	2	6	40	14	1		318
Cincinnati.....			2							2
Cleveland.....		2	3							5
Detroit.....		11	10							21
Indianapolis.....		1								1
Jacksonville.....		1	68		1	3				73
Kansas City.....		1	22		1	27	2	11		64
New York.....		161	349		20	17	9		1	557
Omaha and Council Bluffs.....		2	22			18	11			53
Philadelphia.....		31	253			34	7			325
Pittsburgh.....	1		83				1			85
Portland, Oreg.....						2	4			6
St. Louis.....								3		3
St. Paul and Minneapolis.....	2		4			6	9	1		22
Seattle.....	12		1		5	3	9			30
Spokane.....	1						4			5
Washington.....			2			3	1			6
Total.....	30	405	1, 126	2	36	154	73	18	1	<sup>2</sup> 1, 845

<sup>1</sup> Quarantine No. 38 relates to black stem rust; No. 45, to the gypsy moth and brown-tail moth; No. 48, to the Japanese beetle; No. 52, to the pink bollworm; No. 53, to the satin moth; No. 62, to narcissus pests; No. 63, to the white pine blister rust; No. 64, to the Mexican fruit worm; and No. 71, to the Dutch elm disease.

<sup>2</sup> The total number of violations represents 1,749 shipments, of which 82 were in violation of 2 quarantines, and 7 were in violation of 3 quarantines.

In addition to the figures shown in the table of violations, transit inspectors intercepted 100 shipments moving intrastate in apparent violation of State quarantines relating to pests covered also by Federal quarantine. Of these interceptions 4 were made at Boston, 1 at Detroit, 53 at New York, 13 at Philadelphia, 28 at Pittsburgh, and 1 at Washington.

### TERMINAL INSPECTION OF MAIL SHIPMENTS

Terminal inspection is now maintained in the District of Columbia, in the States of Arizona, California, Florida, Louisiana, Mississippi, Montana, Oklahoma, Oregon, Utah, and Washington, and in the Territories of Hawaii and Puerto Rico. No change has been reported during the year in the inspection points or in the list of plants and plant products subject to terminal inspection.

### CONVICTIONS AND PENALTIES IMPOSED FOR VIOLATIONS OF THE PLANT QUARANTINE ACT

The following convictions and penalties imposed for violations of the Plant Quarantine Act were reported to the Bureau during the year:

European corn borer quarantine (domestic): One conviction, with fine of \$100. Gypsy moth and brown-tail moth quarantine: Two convictions, with fines aggregating \$50.

Japanese beetle quarantine: Six convictions, with fines aggregating \$310.

Quarantines affecting Mexican plant products: Fines aggregating \$452 were imposed by customs officials on the Mexican border against 298 persons caught attempting to smuggle in from Mexico prohibited plants and plant products.

Quarantines affecting Canadian plant products: Fines aggregating \$10 were imposed by customs officials on the Canadian border against two persons caught attempting to smuggle in from Canada prohibited plants.

## FOREIGN PLANT QUARANTINES

Twenty-four foreign plant quarantines and regulatory orders of the Department prohibiting or restricting the entry of various plants and plant products into the United States, 8 domestic quarantines affecting the movement of such material between the Territories of Hawaii and Puerto Rico and continental United States, and 4 miscellaneous regulatory measures are enforced through the Division of Foreign Plant Quarantines by inspectors and collaborators stationed at the more important ports of entry and at points distributing foreign mail, and working in close cooperation with employees of other Federal departments. Detailed information on these quarantines and orders is available in other publications. Enforcement activities in connection with these quarantines and orders are more fully explained in succeeding sections and are accompanied by tables presenting in condensed form records indicating the scope of the work or summarizing its results.

## RECORDS OF IMPORTS OF RESTRICTED PLANTS AND PLANT PRODUCTS

Under the various foreign quarantines and orders certain plants and plant products are restricted as to entry and are subject to inspection and, if necessary, disinfection, for the purpose of excluding plant diseases and insect pests. Among such restricted plants and plant products are nursery stock, plants, bulbs, and seeds; fruits and vegetables; grains from certain countries; cotton, cotton waste, cotton wrappings (bagging), and cottonseed products; cottonseed, seed cotton, and cottonseed hulls from the Imperial Valley, Baja California, Mexico; bagasse; elm logs from European countries (prohibited entry after Jan. 1, 1935); and certain packing materials. A record is given of the importation of the products inspected by inspectors of the Bureau and, if necessary, treated under their supervision.

## IMPORTATIONS OF NURSERY STOCK, PLANTS, BULBS, AND SEEDS

The importations recorded in tables 22 to 24 were entered under permit, subject to inspection and treatment, when necessary, under regulation 3 of Quarantine No. 37.

TABLE 22.—*Importation of fruit and nut cuttings and scions and of rose stocks under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1935*

[Figures indicate actual number of propagating units]

Kind of material	Azores	Belgium	Bulgaria	Canada	Cuba	England	France	Germany	Greece
Cuttings and scions:									
Apple.....			51	1, 198					
Apricot.....			42						
Avocado.....									
Cherry.....			42	54					
Fig.....				18					9
Grape.....	30	20	245	164			163		12
Nut.....									
Peach.....									
Pear.....			56	27					
Pineapple.....					22, 006				
Plum.....			23	680					
Prune.....									
Spondias.....									
Rose stocks.....						622, 000		2, 000	
Total.....	30	20	459	2, 141	22, 006	622, 000	163	2, 000	21



TABLE 22.—*Importation of fruit and nut cuttings and scions, etc.*—Continued

Kind of material	Honduras	Hungary	Italy	Netherlands	Poland	Scotland	Union of Soviet Socialist Republics	Total	
								1935	1934
Cuttings and scions:									
Apple					1,400			2,649	565
Apricot							64	106	63
Avocado	41							41	141
Cherry					875			971	109
Fig			6					15	234
Grape		206	52				75	821	88,051
Nut								164	1,003
Peach									5
Pear					550			633	254
Pineapple								22,006	30
Plum			6		450			1,159	160
Prune			5					5	6
Spondias									16
Rose stocks				5,952,825		23,500		6,600,325	6,536,150
Total	41	206	69	5,952,825	3,275	23,500	139	6,628,895	6,626,787

TABLE 23.—*Importation of bulbs under regulation 3, quarantine no. 37, by country of origin, fiscal year 1935*

Kind of bulbs	Bermuda	Canada	China	Czechoslovakia	England	France	Germany	Greece	India	Ireland
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Chionodoxa		24			6					
Convallaria		62					12,194,980			
Crocus		162			3,940					
Eranthis					200					
Fritillaria		1			200					
Galanthus					7,567		12			150
Hyacinth	4,500	915			12	346,350				
Ixia		6								
Lily	235,975	1,447	3,070	72	3,482	436,056	6	99	6,294	36
Muscari					512		27			
Narcissus <sup>1</sup>			17,880							
Scilla					1,960					
Tulip		959			421	138,950				
Total	240,475	3,576	20,950	72	18,300	921,386	12,195,025	99	6,294	186

Kind of bulbs	Italy	Japan	Manchuria	Mexico	Netherlands	Scotland	Switzerland	Union of South Africa	Union of Soviet Socialist Republics	Total
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Chionodoxa					482,429					482,459
Convallaria					34,985					12,230,027
Crocus					9,057,353		500			9,061,955
Eranthis					301,774					301,974
Fritillaria					364,209					364,410
Galanthus					682,594	9				690,332
Hyacinth	25,000				12,990,104					13,366,881
Ixia					330,775			52		330,833
Lily	2,046	17,514,523	363	2	487,329				90	18,690,920
Muscari					1,147,126					1,147,665
Narcissus <sup>1</sup>										17,880
Scilla					1,482,476	12			1,000	1,485,448
Tulip		41,849			71,050,564				16,719	71,249,462
Total	27,046	17,550,372	363	2	98,411,718	21	500	52	17,809	129,420,246

<sup>1</sup> Narcissus importations under regulation 3 of quarantine no. 37 are limited to importations of the Chinese sacred lily (*Narcissus tazetta* var. *orientalis*), the entry of which is permitted into the Hawaiian Islands for local use and distribution in those islands only.

TABLE 24.—*Importation of seeds under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1935*<sup>1</sup>

Country	Apple	Apricot	Banana	Cherry	Elm	Nut and palm	Orna-mental and tree
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Argentina.....							4
Australia.....						14,761	17
Austria.....	1,067			833			43,599
Bahama Islands.....							4
Belgian Congo.....							2
Bolivia.....						15	
Borneo.....						2	
Brazil.....						181	3
British Guiana.....						8	
British Honduras.....						6	
Canada.....				11		82	7,888
Canal Zone.....						9	3
Ceylon.....							2
China.....					440	1,175	1,114
Colombia.....						64	
Cuba.....						15	7
Czechoslovakia.....	51						25,598
Denmark.....				2			918
Dominica.....							1
Dutch Guiana.....						3	
Ecuador.....						90	
England.....							5
France.....	10,847			1,100		10	17,278
Germany.....				310			1,382
Greece.....							1
Guam.....						3	
Guatemala.....						3	
Honduras.....						11	1
India.....						8	9
Italy.....	200						54,276
Jamaica.....							4
Japan.....		5		1	1,389	1,548	3,005
Java.....							20
Madagascar.....							1
Malay States.....						1	
Manchuria.....					6		410
Mexico.....			11			1	8
Netherlands.....							52
New Zealand.....							3
Norway.....							1
Philippine Islands.....						10	4
Scotland.....							50
Seychelles Islands.....						75	
Spain.....							4
Straits Settlements.....						14	
Tahiti.....						4	
Trinidad.....						208	13
Uganda.....							1
Union of South Africa.....						2	5
Uruguay.....							1
Venezuela.....							9
Total.....	12,165	5	11	2,257	1,835	18,309	155,703

<sup>1</sup> In addition to the importations indicated in this table, the following seeds were imported: Into continental United States, 466 small mail packages of miscellaneous seeds, from 57 foreign countries; into Puerto Rico, 2,188 pounds of ornamental and tree seeds from Canal Zone, Haiti, and India; and into Hawaii, 30 pounds and 4 packages of nut and palm seeds, 270 pounds and 23 packages of ornamental and tree seeds, and 6 pounds and 8 packages of miscellaneous seeds, from Australia, Brazil, Canal Zone, Ecuador, Fiji Islands, France, Germany, Guatemala, India, Japan, Java, New Zealand, Samoa, Society Islands, and the Union of South Africa.



TABLE 24.—*Importation of seeds under regulation 3, Quarantine No. 37, by country of origin, fiscal year 1935—Continued*

Country	Peach	Pear	Persimmon	Plum	Quince	Rose	Miscellaneous	Total
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Argentina.....								4
Australia.....								14, 778
Austria.....	6	213		104	11	5		45, 838
Bahama Islands.....								4
Barbados.....							2	2
Belgian Congo.....								2
Bolivia.....								15
Borneo.....								2
Brazil.....								184
British Guiana.....								8
British Honduras.....							100	106
Canada.....						8		7, 989
Canal Zone.....							1	13
Ceylon.....								2
China.....								2, 729
Colombia.....								64
Cuba.....							1	23
Czechoslovakia.....		94				2		25, 745
Denmark.....						1		921
Dominica.....								1
Dutch Guiana.....								3
Ecuador.....							3	93
England.....						1		6
France.....		140		16				29, 391
Germany.....				100				1, 792
Greece.....								1
Guam.....								3
Guatemala.....								3
Honduras.....								12
India.....	2						2	21
Italy.....								54, 476
Jamaica.....								4
Japan.....	60	955	37			506		7, 506
Java.....								20
Madagascar.....								1
Malay States.....								1
Manchuria.....	20	1				2		439
Mexico.....							10	30
Netherlands.....								52
New Zealand.....								3
Norway.....								1
Philippine Islands.....								14
Scotland.....								50
Seychelles Islands.....								75
Spain.....								4
Straits Settlements.....								14
Tahiti.....								4
Trinidad.....								221
Uganda.....								1
Union of South Africa.....	1							8
Uruguay.....								1
Venezuela.....								9
Total.....	89	1, 403	37	220	11	525	119	192, 689

In addition to the bulbs recorded in table 23, there were imported for propagation under item 6 of this regulation, under permit subject to inspection, 2,312,387 pounds of onion and garlic sets, of which 1,832,291 pounds were imported from Greece and 479,881 pounds from Canada. The remainder was imported in small lots from Denmark, France, Germany, Hungary, and Japan.

In addition to the foregoing, there were imported during the fiscal year 1935 from the Dominion of Canada under regulation 15 of Quarantine No. 37 into continental United States, 875,492 bulbs, plants, trees, and cuttings, and into Hawaii, 421 bulbs, plants, and other materials.

To authorize the importation of this material 859 permits were issued, as compared with 746 permits issued during the fiscal year 1934.

The record of entry under special permits issued under the provisions of regulation 14 of Quarantine No. 37 for the purpose of keeping the country supplied with new varieties and necessary propagating stock and for experimental, educational, or scientific purposes, is furnished in table 25.

TABLE 25.—*Special-permit importations, fiscal year 1935, with combined total for fiscal years 1920-35*

Class of plants	Fiscal year 1935				Total for fiscal years, 1920-35			
	Permits issued		Importations under permits		Permits issued		Importations under permits	
	Number	Quantity <sup>1</sup> authorized	Number	Quantity <sup>1</sup> imported	Number	Quantity <sup>1</sup> authorized	Number	Quantity <sup>1</sup> imported
Dahlia.....	204	7,090	175	4,749	1,163	69,837	998	49,611
Gladiolus.....	156	276,187	145	192,175	2,247	51,184,936	1,913	29,005,153
Iris, bulbous.....	64	1,861,410	41	1,168,543	1,691	56,113,789	1,430	40,522,030
Iris, rhizomatous.....	53	2,870	52	2,371	1,682	300,780	1,451	162,363
Narcissus.....	79	<sup>2</sup> 637,632	82	<sup>2</sup> 900,037	1,553	164,858,074	1,311	80,386,040
Orchid.....	280	21,907	228	13,435	2,620	281,184	2,301	212,218
Peony.....	43	2,653	34	1,697	1,340	1,402,586	1,100	686,850
Rose.....	108	40,533	95	30,014	1,628	314,770	1,447	225,563
Fruit (trees and small fruits).....	42	7,083	33	1,999	301	30,193	211	6,546
Herbaceous.....	211	34,065	167	24,724	2,090	4,921,458	1,674	203,330
Miscellaneous bulbs, roots, etc.....	253	133,335	222	88,007	2,341	13,239,489	2,010	875,273
Ornamental.....	437	270,031	476	196,943	3,322	4,401,992	3,077	11,550,628
Total.....	<sup>3</sup> 1,767	3,294,796	<sup>3</sup> 1,519	<sup>3</sup> 2,624,694	<sup>3</sup> 19,242	297,119,068	<sup>3</sup> 16,251	163,885,605

<sup>1</sup> Quantity refers to number of propagating units, such as plants, bulbs, corms, tubers, cuttings, and other materials.

<sup>2</sup> The difference between the number of narcissus bulbs imported and those authorized may be explained by the fact that some of the permits under which these bulbs were imported were issued during the previous fiscal year.

<sup>3</sup> The disparity between this figure and the actual total of the column above is explained by the fact that a single permit may authorize the entry of more than 1 class of plants and in such instances is listed separately under each class.

During the year 1,767 special permits were issued authorizing the entry of 3,294,796 plants, bulbs, and other materials. A total of 2,624,694 plants, bulbs, etc., were imported, as compared with 668,246 in 1934. Increased importations, as compared with those in 1934, are noted in all classes. The largest increase is in importations of bulbous iris; there were 1,008,520 more iris bulbs imported in 1935 than in 1934. In 1935 more special permits were issued and the number of permits under which importations were made was greater than during any previous year since Quarantine No. 37 was promulgated. Sixty-three percent of the importations were authorized entry by mail under the special arrangement with the Treasury and Post Office Departments whereby plant importations may be made by mail. The distribution of importations of special-permit material by States is shown in table 26.



TABLE 26.—*Distribution, by States, showing plants, bulbs, and other materials, of special-permit material imported during the fiscal year 1935*

State or Territory	Dahlia	Gladiolus	Iris, bulb- ous	Iris, rhi- zomatous	Narcissus	Orchid	Peony
	Number	Number	Number	Number	Number	Number	Number
California.....	119	391	100,024	414	509	3,836	1,151
Colorado.....		10,931					
Connecticut.....	33					400	38
Delaware.....						108	
District of Columbia.....		300			27	10	
Florida.....	10	3	50,013	2	14	2,199	
Hawaii.....	9	64			48	1,088	
Idaho.....		59					
Illinois.....	510	31,908		38			16
Indiana.....	169	12,807		7			
Iowa.....		1,003					
Kentucky.....		655				2	
Louisiana.....						28	
Maryland.....	50	682	50,000		74,518	39	
Massachusetts.....	424	14,091		19		634	12
Michigan.....	34	15,784	2,535		612		34
Minnesota.....	151	8,117		519			
Missouri.....		36				27	
New Hampshire.....		6,000		7		39	
New Jersey.....	1,098	5,220		145		2,204	9
New York.....	951	9,422	256,865	1,009	521,489	429	81
North Carolina.....		5,000	106,000	12	66,447		
North Dakota.....		29,513		70			
Ohio.....	361	2,226	4,000	12	3,998	133	19
Oregon.....	330	27,422	25	96	46,682	23	
Pennsylvania.....	146				101	1,641	19
Puerto Rico.....						432	
Rhode Island.....	80	912			54,525		14
South Dakota.....							131
Tennessee.....			600	8	260		
Texas.....			50,000			19	
Utah.....		604					
Vermont.....		5,957				47	
Virginia.....	65				68,457	2	10
Washington.....	156	84	548,481	13	62,296	5	159
West Virginia.....					54		
Wisconsin.....	53	2,984				90	4
Total.....	4,749	192,175	1,168,543	2,371	900,037	13,435	1,697

State or Territory	Rose	Fruit	Herba- ceous	Miscel- laneous bulbs, roots, etc.	Orna- mental	Total
	Number	Number	Number	Number	Number	Number
Alabama.....					100	100
Arizona.....			4	62	532	598
Arkansas.....				8		8
California.....	185		307	19,417	12,421	138,774
Colorado.....			153		213	11,297
Connecticut.....	12		260	1,016	142	1,901
Delaware.....			4	54	6	172
District of Columbia.....			3	140	41	521
Florida.....			189	2,270	20,658	75,358
Georgia.....	52	100			27	179
Hawaii.....		154		395	431	2,189
Idaho.....						59
Illinois.....	4	107	588	140	172	33,483
Indiana.....	52	3	377	242	27	13,684
Iowa.....						1,003
Kansas.....			4		12	16
Kentucky.....				55	85	797
Louisiana.....	12		5,950		3,105	9,095
Maryland.....			1	2	19	125,311
Massachusetts.....	3	14	338	159	2,843	18,537
Michigan.....	10	18	794	293	184	20,298
Minnesota.....			48	76	42	8,953
Mississippi.....				300		300
Missouri.....	12	6			20	101
Nevada.....				30	6	36
New Hampshire.....		1	49	22	45	6,163
New Jersey.....	3,123	524	3,191	966	42,162	58,642
New Mexico.....				5		5
New York.....	25,468	93	7,562	38,143	99,614	961,124
North Carolina.....				7,965		185,426

TABLE 26.—*Distribution, by States, showing plants, bulbs, and other materials, of special-permit material imported during the fiscal year 1935—Continued*

State or Territory	Rose	Fruit	Herba- ceous	Miscel- laneous bulbs, roots, etc.	Orna- mental	Total
	Number	Number	Number	Number	Number	Number
North Dakota.....						29,583
Ohio.....	27	294	3,913	13,998	10,850	39,831
Oregon.....	59		102	384	37	75,160
Pennsylvania.....	890	299	11	1,181	519	4,807
Puerto Rico.....	40		28	2	17	519
Rhode Island.....			10		500	56,041
South Carolina.....				204		204
South Dakota.....		355	105		122	743
Tennessee.....					61	929
Texas.....	46			188	477	50,730
Utah.....				90		694
Vermont.....				45	4	6,053
Virginia.....					1	68,535
Washington.....	1	1	629	143	1,363	613,331
West Virginia.....	18			12		84
Wisconsin.....			104		85	3,320
Total.....	30,014	1,999	24,724	88,007	196,943	2,624,694

## IMPORTATION OF ELM LOGS UNDER QUARANTINE NO. 70

Under the provisions of Quarantine No. 70, on account of the Dutch elm disease, 50 elm logs from Europe were imported subject to hot-water treatment as follows: Through the port of Baltimore, 20 logs; through New York, 8 logs; and through Norfolk, 22 logs. Hot-water treatment was applied at the following places: Baltimore, 20 logs; Indianapolis, 8 logs; New Albany, Ind., 14 logs; and New York, 8 logs.

Quarantine No. 70, effective October 21, 1933, providing for the entry of elm logs from Europe if free from bark, subject to hot-water treatment as a condition of entry, was amended, effective January 1, 1935, to prohibit the importation of elm logs from Europe. This action was taken for the reason that logs were arriving with the bark incompletely removed. In some cases the adhering remnants of bark were found infested with living adults and larvae of scolytid beetles, which are known to have a part in the spreading of the fungus causing the Dutch elm disease.

## IMPORTATIONS OF COTTON, COTTON WRAPPINGS (BAGGING), COTTONSEED HULLS, AND COTTONSEED PRODUCTS

Tables 27 to 30, inclusive, indicate, respectively, the importations during the fiscal year of cotton, cotton waste, cotton wrappings (bagging), cottonseed hulls, and cottonseed products, which were inspected and, when necessary, fumigated or otherwise treated under supervision. The actual number of bales of cotton, cotton waste, and bagging is indicated and, inasmuch as bales vary in size, they are referred to as running bales.

TABLE 27.—*Importation of running bales of ginned cotton, by country of growth and port of entry, fiscal year 1935*

Country	Boston	Cal- ex- ico	De- troit	El Paso	Fa- bens	Gal- ves- ton	Hous- ton	Island Pond	Mo- bile	New Or- leans	New- port
Anglo-Egyptian Su- dan.....	5,671										
Argentina.....	2										
Brazil.....	303										
British West Indies.....	10										
China.....	900										
Egypt.....	37,545										
India.....	5,176										
Mexico.....		9,500		225	300						
Peru.....	98										
United States (re- turned).....	1,429		421			833	15,215	1	9	2	571
Unknown.....	25										
Total.....	51,159	9,500	421	225	300	833	15,215	1	9	2	571



TABLE 27.—*Importation of running bales of ginned cotton, by country of growth and port of entry, fiscal year 1935—Continued*

Country	New York	Niagara Falls	Norfolk	Portland	Saint Albans	San Francisco	San Pedro	Seattle	Vanceboro	Total
Anglo-Egyptian Sudan										5,671
Argentina										2
Brazil	919						220			1,442
British West Indies	2									12
China	1,867			315		471	424	731		4,708
Ecuador	7									7
Egypt	6,680									44,225
Hawaii						3				3
India	21,997					969	1,864	50		30,056
Japan							150	50		230
Mexico	5,023					3,184	1,907			20,139
Netherland India	1,142					700				1,842
Peru	1,398									1,496
Puerto Rico	19									19
United States (returned)		14			208		3,591		10	22,304
Unknown	24,650		53							24,728
Total	63,704	14	53	315	208	5,327	8,156	861	10	156,884

1 Includes 40, 755 bales linters.

TABLE 28.—*Importation of running bales of cotton waste, by country of origin and port of entry, fiscal year 1935*

Country	Baltimore	Boston	Buffalo	Charleston	Detroit	Houston	New Orleans	Newport	New York	Niagara Falls
Argentina									3	
Belgium		1,808							6,065	
Canada		536	178		314			116		190
China	500	960					50		21,412	
Colombia									165	
Czechoslovakia									109	
England		6,804		6		97			6,080	
France		181							3,010	
Germany									1,048	
India		1,121							25,447	
Italy									178	
Japan	454	1,075		300					15,913	
Netherlands	111	422							1,980	
Scotland		19								
Spain									1,816	
United States (returned)	70									
Total	1,135	12,926	178	306	314	97	50	116	83,217	190

Country	Norfolk	Philadelphia	Portland	Richford	Rouses Point	St. Albans	San Francisco	San Pedro	Savannah	Seattle	Total
Argentina											3
Belgium											7,873
Canada				25	476	1,703					3,538
China		11,984					3,104	803		60	38,873
Colombia											165
Czechoslovakia											100
England	10	159							73		13,229
France							80				3,271
Germany		15									1,063
India		133					50				26,751
Italy											178
Japan		3,435	50				2,927	1,306	200	2,522	28,182
Netherlands											2,513
Scotland											19
Spain											1,816
United States (returned)		5				3					178
Total	10	15,731	50	25	476	1,706	6,161	2,109	273	2,582	127,652

TABLE 29.—*Importation of running bales of bagging, by country of origin and port of entry, fiscal year 1935*

Country	Baltimore	Boston	Buffalo	Charleston	Detroit	Galveston	Houston	Mobile	New Orleans	Newport	New York	Niagara Falls
Algeria											54	
Argentina			36			31	1				142	
Australia											9	
Austria				132								
Belgium		449		225		236	1,032		99		3,977	
Canada		772	102		5,757					90	93	996
China	412			412			207					
Cuba	40								287			
Czechoslovakia				138								
Egypt		216									1,512	
England	54	837		138		6,712	4,456	167	5,183		801	
France		1,539				540	4,604		1,169		1,918	
Germany		134				740	1,566				15	
India	200					159	416				60	
Ireland	69	52									194	
Italy							5,446		297		845	
Japan	1,100	800		9,740		1,241	6,633		8			
Kenya						16						
Netherlands		73		176		43	909		368		1,703	
New Zealand											10	
Norway								560	792			
Portugal							188				219	
Puerto Rico											991	
Rhodesia, Southern						19						
Scotland						10,086					2,081	
Spain						56	916				5,087	
Total	1,875	4,872	138	10,961	5,757	19,879	26,374	727	8,203	90	19,711	996

Country	Norfolk	Philadelphia	Port Huron	Ranier	Rochester	Rouses Point	Saint Albans	San Francisco	Sah Pedro	Savannah	Seattle	Total
Algeria												54
Argentina												210
Australia												9
Austria												132
Belgium	571	44								409		7,042
Canada	360		1,258	12	278	59	50					9,827
China									620			1,651
Cuba												327
Czechoslovakia												138
Egypt												1,728
England	6,020	2,182								1,404		27,954
France	460	62								390		10,682
Germany	149									562		3,166
India												835
Ireland												315
Italy												6,588
Japan	3,000							521	563	2,100	100	25,806
Kenya												16
Latvia	20											20
Netherlands										378		3,650
New Zealand												10
Norway												1,352
Poland	654											654
Portugal												407
Puerto Rico	40											1,031
Rhodesia, Southern												19
Scotland	107											12,274
Spain	564											6,623
Total	11,945	2,288	1,258	12	278	59	50	521	1,183	5,243	100	122,520



TABLE 30.—*Importation of cottonseed hulls and cottonseed products, fiscal year 1935*

Port	Cottonseed hulls <sup>1</sup>	Cottonseed cake	Cottonseed meal	Cottonseed oil
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Gallons</i>
Baltimore.....			3,722,000	
Boston.....			8,566,000	
Brownsville.....		8,641,193	7,000	102,488
Calexico.....	5,827,970			
Eagle Pass.....		8,931,033	972,195	89,907
El Paso.....		514,137	2,370,696	267,672
Hidalgo.....		26,222		
Laredo.....		35,240,323	508,751	511,021
Naco.....				13,336
New York.....		226	21,443,101	
Nogales.....		1	110,205	
Philadelphia.....			4,768,000	
Portland.....		1,117,180	400,000	
Presidio.....			54,167	
San Francisco.....		32	1,000,923	
San Pedro.....			640,000	
Seattle.....		222,000	750,000	
Total.....	5,827,970	54,692,347	<sup>2</sup> 45,313,038	984,424

<sup>1</sup> Cottonseed hulls are permitted entry only from the Imperial Valley, Baja California, Mexico.<sup>2</sup> Includes 7,400,000 pounds of fertilizer composed principally of cottonseed meal.

In addition, the Bureau supervised the entry of 18,883 samples of cotton, cotton linters, cotton waste, and bagging imported by freight, express, and parcel post, and as passenger baggage.

This year's importations of cotton waste are the largest since 1923. Of outstanding interest, however, are the importations of cottonseed cake, meal, and oil, which represent for each commodity the largest yearly importations since cottonseed products were placed under restriction in July 1917. A comparison of the importations of these several commodities with the average yearly importations thereof for the preceding 10-year period, July 1, 1924, to June 30, 1934, is as follows, with figures for this year's importations given first: Cotton waste, 127,652 bales—52,843.4 bales; cottonseed cake, 54,692,347 pounds—2,448,677.5 pounds; cottonseed meal, 45,313,038 pounds—1,128,339.2 pounds; cottonseed oil, 984,424 gallons—2.55 gallons.

During the 10 preceding years a total of only 63 permits were issued for the entry of cottonseed cake, meal, and oil. This year 265 permits were issued.

#### IMPORTATIONS OF GRAIN, BROOMS, AND BROOMCORN

Table 31 shows the importations of shelled corn and seeds of related plants inspected under the provisions of Quarantine No. 41.

TABLE 31.—*Importation of clean shelled corn and clean seed of other plants covered by Quarantine No. 41, by country of growth, fiscal year 1935*

Country	Corn	Sorghum	Sudan grass	Country	Corn	Sorghum	Sudan grass
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Argentina.....	829,909,611	269,581	7,133,382	Manchuria.....		1,500,000	
Australia.....			2,778,630	Mexico.....	321,758,863		
Bahamas.....	75			Netherlands.....	336		
Brazil.....	132		35,801	Rhodesia.....			
Bulgaria.....	11			Southern.....	17,244,584		
Canada.....	198,159			Rumania.....	30,604,610		
Chile.....	8			Union of South Africa.....	50,728,765		59,065
Cuba.....	824,926			United States (returned).....	149,771,247		
Dominican Republic.....	11,314,222			Venezuela.....	42		
England.....	28,332			Yugoslavia.....	10,109,803		
Haiti.....	87,500			Total.....	1,436,113,396	1,769,581	10,567,926
Hungary.....			561,048				
Italy.....	50						
Kenya.....	13,532,120						

TABLE 32.—*Importation of brooms and broomcorn under Quarantine No. 41, by country of origin, fiscal year 1935*

Country	Brooms	Broom-corn	Country	Brooms	Broom-corn
	Number	Bales		Number	Bales
Argentina.....		11,391	Mexico.....	49,664	1,123
Hungary.....		32,950			
Italy.....	14,892	2,877	Total.....	64,556	48,341

In addition, inspection was made under Quarantine No. 41 of the following: Corn on the cob, green, 20,165 pounds; and corn on the cob, mature, 4,070 pounds.

The Bureau also supervised the entry under Quarantine No. 24 of 5,000,105 pounds of shelled corn and under Quarantine No. 55 of the following: Seed or paddy rice, 2,488,671 pounds; rice straw, 5,400 bales; and articles made of rice straw, 914.

The entry of shelled corn has been restricted from all foreign countries and localities by quarantines since January 1, 1927. This year's importations of shelled corn under existing corn Quarantines Nos. 24 and 41 represent the largest yearly importations since that date. They total 1,441,113,501 pounds. The average yearly importations under these two quarantines during the 7½-year preceding period were 58,675,188 pounds. The importations under Quarantine No. 41 of sorghum seed, Sudan grass seed, and broomcorn are also without precedent in point of size. Importations of sorghum seed amounted to 1,769,581 pounds and of Sudan grass seed to 10,567,926 pounds. The respective average yearly importations of these two commodities for the 7½ preceding years were 56,023.6 pounds and 70,703.6 pounds. Broomcorn importations (table 32) totaled 48,341 bales this year. The average yearly importations of this commodity for the 10-year preceding period, July 1, 1924, to June 30, 1934, were 586.2 bales. Under Quarantines Nos. 24 and 41, the number of permits issued this year was 644. Last year 172 permits were issued.

This year's importations of seed or paddy rice from Mexico under Quarantine No. 55 are the largest since 1930. (The entry of seed or paddy rice is prohibited from all other foreign countries and localities.)

#### IMPORTATION OF BAGASSE UNDER QUARANTINE NOS. 15 AND 16

Effective October 1, 1934, Foreign Sugarcane Quarantine No. 15 was amended to authorize the entry of specific materials on condition that they have been or are to be so treated, processed, or manufactured that, in the judgment of the Department, their entry will involve no pest risk.

Effective January 1, 1935, Domestic Sugarcane Quarantine No. 16 was similarly amended to allow entry from Puerto Rico and Hawaii.

Under these quarantines as amended importations have been made under permit as follows: Under Quarantine No. 15, from foreign countries—bagasse, 3,729,136 pounds, and bagasse dust, 765 pounds; under Quarantine No. 16, from Puerto Rico and Hawaii—bagasse, 56,136 pounds, and bagasse flour, 70 pounds.

#### IMPORTATIONS OF FRUITS AND VEGETABLES

Tables 33 and 34 show by countries of origin and ports of entry, respectively, the kinds and quantities of fruits and vegetables imported into the continental United States and into Hawaii and Puerto Rico during the fiscal year under permit and subject to inspection at the port of first arrival under the provisions of Quarantine No. 56, as well as importations of mandarin oranges under Quarantine No. 28, and potatoes under the regulations governing the importation of potatoes into the United States. The total of these importations is 52,226,825 bunches of bananas, 743,425 crates of pineapples, and 246,763,579 pounds of all other commodities listed. On the basis of weight it is estimated that the total importations are approximately 25 percent in excess of those made during the preceding year. In addition, 746 emergency permits were issued for the entry of small lots of fruits and vegetables found in passengers' baggage, involving kinds previously approved for entry at the ports in question.



TABLE 33.—*Fruits and vegetables imported, by countries of origin, fiscal year 1935*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Country and quantity	Total
Apple.....pounds	Denmark, 163; England, 100; Netherlands, 550; Newfoundland, 96; New Zealand, 916,650; Sweden, 50.	917,609
Apricot.....do	Chile, 22,130	22,130
<i>Aralia cordata</i> .....do	Japan, 2,120	2,120
Arrowhead.....do	China, 170,574; Japan, 250	170,824
Artichoke:		
Globe.....do	Argentina, 60	60
Jerusalem.....do	Mexico, 70	70
Asparagus.....do	Argentina, 106,822; Chile, 3,416; Mexico, 35	110,273
<i>Asperula odorata</i> .....do	Germany, 5½	5½
Avocado.....do	Cuba, 6,296,401; Mexico (seeds removed), 39,112	6,335,513
Balsamapple.....do	Cuba, 2,166; Mexico, 3,500	5,666
Banana.....bunches	British Honduras, 341,234; Cayman Islands, 89; Colombia, 3,627,126; Costa Rica, 2,898,535; Cuba, 6,207,932; Dominica, 2; Dominican Republic, 3,350; Ecuador, 1,061,074; Guadeloupe, 187; Guatemala, 4,580,748; Haiti, 577,902; Honduras, 13,978,090; Jamaica, 1,470,582; Martinique, 13; Mexico, 8,852,160; Nicaragua, 3,110,454; Panama (including Canal Zone), 5,517,299; Trinidad, 48.	52,226,825
Bean (green):		
Faba.....pounds	Mexico, 107	107
Lima.....do	Cuba, 3,582,922; Mexico, 65,628	3,648,550
String.....do	Cuba, 29,927; Mexico, 996,609	1,026,536
Beet.....do	Cuba, 250; Mexico, 230,821	231,071
Berry ( <i>Rubus</i> ):		
Frozen.....do	Scotland, 171,000	171,000
Natural.....do	Norway, 1,547; Scotland, 150,000	151,547
Broccoli.....do	Cuba, 25	25
Cabbage.....do	Cuba, 22,080; Mexico, 29,824; Netherlands, 391,000	442,904
Cacao bean pod.....do	Costa Rica, 216; Trinidad, 763	979
Cactus.....do	Mexico, 6,535	6,535
Carrot.....do	Bermuda, 500; Cuba, 2,135; Mexico, 484,994	487,629
Cassava.....do	Cayman Islands, 175; China, 300; Cuba, 171,593; Guatemala, 20; Panama (including Canal Zone), 750	172,838
Cauliflower.....do	Mexico, 1,474	1,474
Celery.....do	Cuba, 221; Mexico, 32	253
Chayote.....do	Cuba, 15,414; Jamaica, 30; Mexico, 1,938	17,382
Cherry:		
Dried, sour.....do	Yugoslavia, 689,953	689,953
Fresh.....do	Argentina, 1,763; Chile, 11,023	12,786
Chinese watermelon.....do	Cuba, 100	100
Cipollino.....do	Greece, 1,698; Morocco, 2,580,904	2,582,602
<i>Citrus medica</i> .....do	Albania, 3,240; Algeria, 100; Italy, 397; Palestine, 14,207	17,944
Clover top.....do	Mexico, 571	571
Coriander.....do	Mexico, 369	369
Cowpea.....do	Mexico, 150	150
<i>Crescentia alata</i> .....do	Mexico, 2	2
Crosnes.....do	Belgium, 498	498
Cucumber.....do	Cuba, 2,139,631; Dominican Republic, 130; Mexico, 29,650	2,169,411
Dasheen (includes colocasia, inhame, malanga, taro, and yautia), pounds.	Azores, 261,950; China, 309,001; Cuba, 175,203; Dominican Republic, 1,256,641; Haiti, 2,100; Honduras, 25; Jamaica, 30; Japan, 146,350; Mexico, 983; Nicaragua, 500	2,152,783
Eggplant.....pounds	Cuba, 4,857,581; Dominican Republic, 624; Mexico, 381,917	5,240,122
Endive.....do	Belgium, 1,047,935	1,047,935
Garbanzo.....do	Mexico, 32	32
Garlic.....do	British Guiana, 6; Chile, 2,699,310; China, 4,806; Cuba, 15,000; Egypt, 7,100; Greece, 75; Italy, 686; Japan, 532; Mexico, 2,201,397; New Zealand, 2,100; Spain, 1,166,654; Uruguay, 1,540	6,099,206
Ginger (crude).....do	China, 352,404; Cuba, 18,604; Ecuador, 1,500; Japan, 469; Mexico, 32	373,009
Gourd.....do	Mexico, 7	7
Grape.....do	Argentina, 9,021,796; Chile, 266,112; Mexico, 652; Spain, 7,568,541	16,857,101
Grape (hothouse).....do	Belgium, 81,832; Netherlands, 470	82,302
Grapefruit.....do	Cuba, 7,528,511; Haiti, 1,200	7,529,711
Horseradish.....do	Germany, 1,590; Sweden, 2,262	3,852
Husk tomato.....do	Mexico, 8,003	8,003
Japanese horseradish.....do	Japan, 555	555
Kale.....do	Bermuda, 190,610	190,610
Kohlrabi.....do	Mexico, 218	218
Kudzu.....do	China, 66,113; Cuba, 180	66,293

Footnotes at end of table.

TABLE 33.—*Fruits and vegetables imported, by countries of origin, fiscal year 1935—Continued*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Country and quantity	Total
Leek.....pounds..	Cuba, 585	585
Lemon.....do.....	Cuba, 480; Italy, 781,843; Mexico, 53; Uruguay, 800	783, 176
Lettuce.....do.....	Mexico, 39,260	39,260
Lily bulb (edible).....do.....	China, 25,850; Japan, 165	26, 015
Lime (sour).....do.....	Antigua, 3,450; Argentina, 700; Cuba, 51,001; Dominica, 677,386; Dominican Republic, 16,024; Grenada, 31,407; Haiti, 14,867; Honduras, 17,475; Jamaica, 174,630; Mexico, 7,232,708; Montserrat, 338,934; Panama (including Canal Zone), 2,440; Peru, 8; St. Lucia, 800,238; St. Vincent, 3,000; Trinidad, 120,975; Virgin Islands, 14,817	9, 500, 060
Mango (seeds removed, frozen).....do.....	Philippine Islands, 408	408
Melon.....do.....	Argentina, 177,130; Chile, 4,378,836; Mexico, 1,638,102; Peru, 3,954; Spain, 1,264,299	7, 462, 321
Mint.....do.....	Cuba, 4,520; Mexico, 28	4, 548
Mustard.....do.....	Cuba, 8,624; Mexico, 95,053	103, 677
Nectarine.....do.....	Chile, 298,480	298, 480
Nectarine (hothouse).....do.....	Belgium, 7½	7½
Nopale.....do.....	Mexico, 515	515
Nuts:		
Acorn.....do.....	Turkey, 23,889,770	23, 889, 770
Chestnut.....do.....	China, 16,280; Italy, 13,024,479; Japan, 609,038; Portugal, 844,696; Spain, 8,816	14, 503, 309
Okra.....do.....	Cuba, 1,338,324; Mexico, 66,040	1, 404, 364
Onion.....do.....	Argentina, 837,752; Australia, 249,097; Bermuda, 91; Chile, 4,232,170; Cuba, 12,651; Egypt, 2,722,430; Hungary, 14; Italy, 1,803,224; Japan, 100,000; Mexico, 392,385; Netherlands, 49,280; Philippine Islands, 35; Portugal, 500; Spain, 253,173	10, 652, 802
Orange:		
Under quarantine no. 56:		
Fresh.....do.....	Cuba, 51,753; St. Lucia, 120	51, 873
Frozen.....do.....	Spain, 1,473	1, 473
Mandarin (quarantine no.28).....do.....	Japan, 1,610,264	1, 610, 264
Papaya.....do.....	Cuba, 73,581	73, 581
Parsley.....do.....	Bermuda, 1,400; Cuba, 50; Mexico, 15,914	17, 364
Pea.....do.....	Cuba, 3,405; Mexico, 4,214,474	4, 217, 879
Peach.....do.....	Argentina, 9,970; Chile, 66,376	76, 346
Peach (hothouse).....do.....	Belgium, 47	47
Pear.....do.....	Argentina, 92,328; Chile, 72,571	164, 899
Pepper.....do.....	Bahamas, 90; Cuba, 4,330,210; Mexico, 3,763,778	8, 094, 078
Pigweed.....do.....	Mexico, 1,015	1, 015
Pineapple.....crates..	Azores, 25; Costa Rica, 5; Cuba, 672,389; Dominican Republic, 3,493; Ecuador, 6; Guatemala, 3; Haiti, 183; Honduras, 149; Jamaica, 1; Mexico, 67,169; Panama (including Canal Zone), 2	743, 425
Plantain.....pounds..	Argentina, 2,186; British Honduras, 458,740; Cayman Islands, 3,575; Colombia, 3,242; Cuba, 6,133,550; Dominican Republic, 7,044,950; Haiti, 249,448; Honduras, 462,325; Jamaica, 100; Mexico, 59,820; Nicaragua, 2,700; Panama (including Canal Zone), 486,598; Virgin Islands, 220	14, 907, 454
Plum.....do.....	Argentina, 51,370; Chile, 40,295	91, 665
Potato:		
Under quarantine no. 56.....do.....	Bermuda, 999,794	999, 794
Under potato regulations (order of Dec. 22, 1913).....pounds..	Canary Islands, 40,000; Cuba, 2,165,789; Mexico, 57,623; Spain, 49,068	2, 312, 480
Pumpkin.....do.....	Cuba, 101,165; Dominican Republic, 24,033; Mexico, 10,876	136, 074
Purslane.....do.....	Mexico, 1,938	1, 938
Radish.....do.....	Cuba, 677; Mexico, 123,128	123, 805
Roselle.....do.....	Mexico, 30	30
St. Johns bread.....do.....	Cyprus, 785,462; Greece, 22,400; Italy, 290,470	1, 098, 332
Salsify.....do.....	Mexico, 1,527	1, 527
Shallot.....do.....	Belgium, 616	616
Spinach.....do.....	Mexico, 67,734	67, 734
Squash.....do.....	Bermuda, 30; Cuba, 16,853; Mexico, 76,236	93, 119
Strawberry.....do.....	Cuba, 15; Mexico, 7,326	7, 341
Sweetpotato.....do.....	China, 4,200	4, 200
Swiss chard.....do.....	Mexico, 11,451	11, 451
Tamarind bean pod.....do.....	Antigua, 108,506; Barbados, 2,000; Cuba, 1,000; India, 58,629; Mexico, 1,079; Montserrat, 13,100; St. Lucia, 15,991	200, 305
Tomato.....do.....	Argentina, 9,018; Bahamas, 143,643; Canary Islands, 42,792; Cuba, 41,870,159; Mexico, 35,479,651; Virgin Islands, 56,580	77, 601, 843
Turnip.....do.....	Cuba, 2,778; Mexico, 259,182	261, 960

Footnotes at end of table.



TABLE 33.—*Fruits and vegetables imported, by countries of origin, fiscal year 1935—Continued*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Country and quantity	Total
<i>Vaccinium</i> (cranberry, etc.):		
Frozen.....pounds..	Newfoundland, 3,498,349.....	3,498,349
Natural.....do.....	Finland, 13,211; Newfoundland, 657,051; Norway, 9,346; Sweden, 2,868.....	682,476
Water caltrop.....do.....	China, 11,480; Japan, 20.....	11,500
Waterchestnut.....do.....	China, 2,061,188.....	2,061,188
Watercress.....do.....	Mexico, 3,647.....	3,647
Waterlily root.....do.....	China, 16,602; Cuba, 55,378.....	71,980
Watermelon.....do.....	Cuba, 108,090; Mexico, 312,819.....	420,909
Yam <sup>1</sup> .....do.....	China, 23,400; Japan, 12,011.....	35,411
Yam bean root.....do.....	China, 27,100; Mexico, 2,009.....	29,109

<sup>1</sup> Sterilized by refrigeration.<sup>2</sup> These sweetpotatoes and yams were imported into Hawaii. Although the importation of sweetpotatoes and yams into continental United States is prohibited by Quarantines 29 and 30, that prohibition does not apply to Hawaii or Puerto Rico.TABLE 34.—*Fruits and vegetables imported by ports of entry, fiscal year 1935*

[Imported under Quarantine No. 56 unless otherwise designated]

Kind	Port and quantity	Total
Apple.....pounds..	Los Angeles, 550; New York, 917,059.....	917,609
Aprioot.....do.....	New York, 22,130.....	22,130
<i>Aralia cordata</i> .....do.....	Hawaii (all ports), 2,120.....	2,120
Arrowhead.....do.....	Boston, 6,000; Buffalo, 13,400; Detroit, 200; Hawaii (all ports), 25,450; Los Angeles, 1,000; New York, 42,800; Niagara Falls, 2,200; Portland, 1,700; San Francisco, 72,110; Seattle, 5,964.....	170,824
Artichoke:		
Globe.....do.....	New York, 60.....	60
Jerusalem.....do.....	Laredo, 20; San Ysidro, 50.....	70
Asparagus.....do.....	Calexico, 13; New York, 110,238; San Ysidro, 22.....	110,273
<i>Asperula odorata</i> .....do.....	New York, 5½.....	5½
Avocado.....do.....	Baltimore, 414; Boston, 80; Brownsville (seeds removed), 24,057; Douglas (seeds removed), 15; Eagle Pass (seeds removed), 5,551; El Paso (seeds removed), 3,323; Hidalgo (seeds removed), 888; Jacksonville, 420; Key West, 710,689; Laredo (seeds removed), 4,133; Mercedes (seeds removed), 307; Miami, 56,848; New Orleans, 2,484,579; New York, 1,599,478; Nogales (seeds removed), 118; Philadelphia, 1,080; Rio Grande City (seeds removed), 146; Roma (seeds removed), 574; Tampa, 1,442,813.....	6,335,513
Balsamapple.....do.....	Calexico, 3,500; New York, 2,166.....	5,666
Banana.....bunches..	Aberdeen, 1,270; Baltimore, 3,498,969; Blaine, 3,559; Boston, 3,082,748; Brownsville, 68,536; Buffalo, 1,050; Calexico, 1; Charleston, 1,214,970; Corpus Christi, 13,893; Detroit, 12,955; Eagle Pass, 12,511; Eastport, 3; El Paso, 337,901; Galveston, 2,547,493; Hidalgo, 1,405; Houston, 47,887; Jacksonville, 976,921; Key West, 1,020; Laredo, 560,582; Los Angeles, 1,931,816; Miami, 250,176; Mobile, 2,123,498; New Orleans, 13,525,289; New York, 14,315,282; Nogales, 6,048; Norfolk, 632,728; Philadelphia, 4,620,688; Portland, 2,850; Puerto Rico (all ports), 464; San Francisco, 1,424,971; San Ysidro, 1; Sault Ste. Marie, 3,530; Seattle, 289,417; Sumas, 40,574; Tacoma, 1,757; Tampa, 674,060; Ysleta, 2.....	52,226,825
Bean (green):		
Faba.....pounds..	Calexico, 5; Nogales, 99; San Ysidro, 3.....	107
Lima.....do.....	Laredo, 17,677; New York, 3,582,922; Nogales, 46,870; San Ysidro, 1,081.....	3,648,550
String.....do.....	Brownsville, 1,339; Calexico, 2,403; Douglas, 2,831; Eagle Pass, 941; El Paso, 38,464; Laredo, 292,741; Mercedes, 2; Naco, 803; New York, 29,927; Nogales, 632,044; San Ysidro, 25,031; Ysleta, 10.....	1,026,536
Beet.....do.....	Calexico, 2,402; Douglas, 440; Eagle Pass, 235; El Paso, 219,126; Naco, 40; New Orleans, 270; New York, 250; Nogales, 8,042; San Ysidro, 158; Ysleta, 108.....	231,071

TABLE 34.—*Fruits and vegetables imported by ports of entry, fiscal year 1935—Continued*

[Imported under Quarantine No. 56, unless otherwise designated]

Kind	Port and quantity	Total
Berry ( <i>Rubus</i> ):		
Frozen.....pounds..	New York, 171,000.....	171,000
Natural.....do.....	New York, 151,547.....	151,547
Broccoli.....do.....	New York, 25.....	25
Cabbage.....do.....	Calexico, 1,525; Douglas, 5,211; Eagle Pass, 546; El Paso, 797; Laredo, 685; Naco, 1,145; New York, 413,080; Nogales, 19,703; San Ysidro, 212.....	442,904
Cacao bean pod.....do.....	New York, 979.....	979
Cactus.....do.....	Brownsville, 40; Calexico, 4; El Paso, 1,959; Laredo, 4,511; Mercedes, 3; Nogales, 10; San Ysidro, 8.....	6,535
Carrot.....do.....	Brownsville, 5; Calexico, 3,935; Douglas, 434; Eagle Pass, 355; El Paso, 452,741; Miami, 110; Naco, 170; New Orleans, 900; New York, 1,625; Nogales, 25,803; San Ysidro, 340; Ysleta, 1,211.....	487,629
Cassava.....do.....	Key West, 4,353; New Orleans, 20; New York, 167,330; Seattle, 300; Tampa, 835.....	172,838
Cauliflower.....do.....	Calexico, 67; Douglas, 48; Eagle Pass, 30; Nogales, 1,315; San Ysidro, 14.....	1,474
Celery.....do.....	Calexico, 18; New York, 221; San Ysidro, 14.....	253
Chayote.....do.....	El Paso, 140; Key West, 825; Laredo, 1,798; Miami, 3,796; New Orleans, 4,309; New York, 6,514.....	17,382
Cherry:		
Dried, sour.....do.....	Boston, 56,490; New York, 567,324; Philadelphia, 66,139.....	689,953
Fresh.....do.....	New York, 12,786.....	12,786
Chinese watermelon.....do.....	New York, 100.....	100
Cipollino.....do.....	New York, 2,582,602.....	2,582,602
<i>Citrus medica</i> .....do.....	Detroit, 140; El Paso, 1; New York, 17,803.....	17,944
Clover top.....do.....	Douglas, 571.....	571
Coriander.....do.....	Calexico, 369.....	369
Cowpea.....do.....	Laredo, 150.....	150
<i>Crescentia alata</i> .....do.....	Nogales, 2.....	2
Crosnes.....do.....	New York, 498.....	498
Cucumber.....do.....	Calexico, 318; Douglas, 1,071; Eagle Pass, 102; Key West, 128,091; Laredo, 500; Mercedes, 2; Miami, 93,800; Naco, 283; New Orleans, 83,200; New York, 1,773,216; Nogales, 27,348; Tampa, 61,454; San Ysidro, 26.....	2,169,411
Dasheen (includes colocasia, inhame, malanga, taro, and yautia), pounds.	Boston, 132,698; Buffalo, 7,480; Calexico, 983; Detroit, 1,800; Key West, 6,855; Los Angeles, 9,000; Miami, 100; New York, 1,130,507; Niagara Falls, 13,555; Portland, 9,428; Puerto Rico (all ports), 419,222; San Francisco, 282,100; Seattle, 113,888; Tampa, 25,167.....	2,152,783
Eggplant.....pounds..	Brownsville, 330; Calexico, 10; El Paso, 707; Key West, 23,620; Laredo, 1,297; Miami, 3,015; New Orleans, 334,122; New York, 4,437,545; Nogales, 379,553; San Ysidro, 20; Tampa, 59,903.....	5,240,122
Endive.....do.....	New York, 1,047,935.....	1,047,935
Garbanzo.....do.....	Nogales, 32.....	32
Garlic.....do.....	Boston, 84,400; Brownsville, 10,550; Calexico, 131,921; Douglas, 1,633; Eagle Pass, 12,015; El Paso, 38,943; Hawaii (all ports), 7,132; Hidalgo, 3,998; Laredo, 1,242,078; Mercedes, 24; Naco, 1,100; New Orleans, 155,613; New York, 2,769,827; Nogales, 23,423; Puerto Rico (all ports), 1,614,086; San Francisco, 306; San Ysidro, 2,157.....	6,099,206
Ginger (crude).....do.....	Boston, 8,245; Buffalo, 11,370; Calexico, 32; Chicago, 800; Detroit, 600; Hawaii (all ports), 1,300; Los Angeles, 15,200; New York, 83,208; Niagara Falls, 14,700; Portland, 1,445; San Francisco, 209,401; Seattle, 26,708.....	373,009
Gourd.....do.....	Mercedes, 7.....	7
Grape.....do.....	Boston, 870,044; Brownsville, 150; Calexico, 219; Eagle Pass, 205; Laredo, 56; New York, 15,986,405; Nogales, 22.....	16,857,101
Grape (hothouse).....do.....	New York, 82,302.....	82,302
Grapefruit.....do.....	Boston, 860; Key West, 1,342,810; New Orleans, 1,058,349; New York, 5,127,692.....	7,529,610
Horseradish.....do.....	New York, 3,852.....	3,852
Husk tomato.....do.....	Brownsville, 60; Calexico, 15; Eagle Pass, 3,346; El Paso, 4,540; Nogales, 2; San Ysidro, 40.....	8,003
Japanese horseradish.....do.....	Hawaii (all ports), 555.....	555
Kale.....do.....	New York, 190,610.....	190,610
Kohlrabi.....do.....	Calexico, 53; El Paso, 165.....	218
Kudzu.....do.....	Boston, 1,800; Buffalo, 4,516; Detroit, 300; Los Angeles, 700; New York, 11,680; Niagara Falls, 5,100; Portland, 1,000; San Francisco, 38,797; Seattle, 2,900.....	66,293
Leek.....do.....	Miami, 135; New York, 450.....	585



TABLE 34.—Fruits and vegetables imported by ports of entry, fiscal year 1935—Continued

[Imported under Quarantine No. 56, unless otherwise designated]

Kind	Port and quantity	Total
Lemon.....pounds.....	Calexico, 1; Mercedes, 2; New York, 783,123; San Ysidro, 50.	783, 176
Lettuce.....do.....	Calexico, 1,327; Douglas, 3,482; Eagle Pass, 1,894; El Paso, 280; Naco, 565; Nogales, 31,552; San Ysidro, 160.	39, 260
Lily bulb (edible).....do.....	Boston, 1,500; Buffalo, 1,440; Detroit, 360; Hawaii (all ports), 2,015; New York, 5,300; Niagara Falls, 1,700; Portland, 300; San Francisco, 12,100; Seattle, 1,300.	26, 015
Lime (sour).....do.....	Baltimore, 13,258; Boston, 79,305; Brownsville, 234,801; Eagle Pass, 1,011,485; El Paso, 300,996; Hidalgo, 2,538; Key West, 1,980; Laredo, 4,822,488; Los Angeles, 736,075; Mercedes, 8; Miami, 3,691; New Orleans, 7,057; New York, 2,247,334; Nogales, 23,128; Philadelphia, 2,421; Presidio, 28; Puerto Rico (all ports), 1,562; San Francisco, 10,317; Tampa, 1,588.	9, 500, 060
Mango (seeds removed) (frozen).....do.....	Portland, 408.	408
Melon.....do.....	Calexico, 1,102; Douglas, 561; Hidalgo, 370; Laredo, 1,590,759; Mercedes, 109; Naco, 10; New York, 5,824,219; Nogales, 44,976; Rio Grande City, 4; San Ysidro, 211.	7, 462, 321
Mint.....do.....	Calexico, 1; El Paso, 15; New York, 4,520; Nogales, 12.	4, 548
Mustard.....do.....	Calexico, 12,641; Douglas, 137; El Paso, 79,016; Naco, 60; New York, 8,624; Nogales, 3,189; San Ysidro, 10.	103, 677
Nectarine.....do.....	New York, 298,480.	298, 480
Nectarine (hothouse).....do.....	New York, 7½.	7½
Nopale.....do.....	Douglas, 222; Nogales, 293.	515
Nuts:		
Acorn.....do.....	New York, 21,000,859; Norfolk, 1,786,740; Philadelphia, 1,102,171.	23, 889, 770
Chestnut.....do.....	Boston, 136,028; Hawaii (all ports), 122,561; Los Angeles, 331,763; New York, 13,664,513; San Francisco, 218,714; Seattle, 29,280; Tampa, 450.	14, 503, 309
Okra.....do.....	Brownsville, 1 80; Calexico, 42; El Paso, 140; Key West, 25,975; Laredo, 1 65,778; Miami, 11,127; New Orleans, 436,172; New York, 509,199; Tampa, 355,851.	1, 404, 364
Onion.....do.....	Boston, 1,471,160; Brownsville, 940; Calexico, 17,771; Douglas, 10,934; Eagle Pass, 14,260; El Paso, 166,906; Hawaii (all ports), 79,401; Key West, 6; Laredo, 142,004; Mercedes, 34; Miami, 2,550; Naco, 3,725; New York, 8,429,974; Nogales, 35,254; Portland, 35; San Francisco, 20,096; San Ysidro, 97; Seattle, 249,600; Tampa, 7,595; Ysleta, 410.	10, 652, 802
Orange:		
Under Quarantine No. 56:		
Fresh.....do.....	Boston, 2,800; Key West, 42,688; New York, 6,385.	51, 873
Frozen.....do.....	Baltimore, 1,473.	1, 473
Mandarin (Quarantine No. 28).....do.....	Portland, 200,635; Seattle, 1,409,629.	1, 610, 264
Papaya.....do.....	Key West, 13,559; Miami, 24,819; New York, 32,233; Tampa, 2,970.	73, 581
Parsley.....do.....	Calexico, 20; Douglas, 61; El Paso, 15,724; Naco, 65; New York, 1,450; Nogales, 2; Ysleta, 42.	17, 364
Pea.....do.....	Calexico, 215; Douglas, 1,432; Eagle Pass, 5; Laredo, 1,480; Naco, 295; New York, 3,405; Nogales, 4,101,173; San Ysidro, 109,874.	4, 217, 879
Peach.....do.....	New York, 76,346.	76, 346
Peach (hothouse).....do.....	New York, 47.	47
Pear.....do.....	New York, 164,899.	164, 899
Pepper.....do.....	Brownsville, 1,926; Calexico, 3,259; Del Rio, 451; Douglas, 11,379; Eagle Pass, 52,711; El Paso, 267,650; Hidalgo, 1,142; Key West, 46,050; Laredo, 113,353; Mercedes, 61; Miami, 3,512; Naco, 2,410; New Orleans, 215,918; New York, 4,038,751; Nogales, 3,275,656; Presidio, 142; Rio Grande City, 12; San Ysidro, 32,613; Sasabe, 50; Tampa, 26,069; Ysleta, 963.	8, 094, 078
Pigweed.....do.....	Douglas, 536; Nogales, 479.	1, 015
Pineapple.....do.....	Baltimore, 17; Boston, 11; Brownsville, 1,160; Douglas, 9; Eagle Pass, 2,192; El Paso, 14,103; Jacksonville, 39; Key West, 366,156; Laredo, 47,528; Los Angeles, 30; Miami, 12,005; Naco, 4; New Orleans, 59,260; New York, 227,420; Nogales, 48; Puerto Rico (all ports), 41; San Francisco, 2; Tampa, 13,395.	743, 425

<sup>1</sup> Okra was admitted from Tamaulipas, Mexico, through the ports of Brownsville and Laredo under special conditions.

TABLE 34.—*Fruits and vegetables imported by ports of entry, fiscal year 1935—Continued*

[Imported under Quarantine No. 56, unless otherwise designated]

Kind	Port and quantity	Total
Plantain.....pounds..	Baltimore, 55,500; Key West, 426,962; Los Angeles, 3,120; Miami, 207,915; New Orleans, 589,005; New York, 5,454,953; Philadelphia, 82,310; Puerto Rico (all ports), 6,951,229; San Francisco, 40,386; Tampa, 1,096,074.	14,907,454
Plum.....do.....	New York, 91,665.	91,665
Potato:		
Under Quarantine No. 56.....do.....	New York, 999,794.	999,794
Under potato regulations (order of Dec. 22, 1913.).....pounds..	Douglas, 25,040; Naco, 5,900; New Orleans, 9,494; New York, 2,156,295; Nogales, 26,633; Puerto Rico (all ports), 89,068.	2,312,480
Pumpkin.....do.....	Calexico, 985; Douglas, 2,100; Key West, 2,926; Laredo, 3,354; Mercedes, 1,901; Miami, 300; Naco, 1,420; New York, 121,272; Nogales, 1,061; Rio Grande City, 12; San Ysidro, 43; Tampa, 700.	136,074
Purslane.....do.....	Calexico, 768; Douglas, 277; El Paso, 40; Nogales, 853.	1,938
Radish.....do.....	Calexico, 3,613; Douglas, 58; Eagle Pass, 29; El Paso, 111,747; Naco, 25; New York, 677; Nogales, 7,618; San Ysidro, 32; Ysleta, 6.	123,805
Roselle.....do.....	Nogales, 30.	30
St. Johns bread.....do.....	New York, 988,102; Norfolk, 110,230.	1,098,332
Salsify.....do.....	San Ysidro, 1,527.	1,527
Shallot.....do.....	New York, 616.	616
Spinach.....do.....	Calexico, 4,862; Douglas, 1,257; El Paso, 37,792; Naco, 495; Nogales, 22,944; San Ysidro, 100; Ysleta, 284.	67,734
Squash.....do.....	Calexico, 3,595; Douglas, 7,943; Eagle Pass, 2,495; El Paso, 17,358; Hidalgo, 75; Laredo, 10,163; Mercedes, 576; Miami, 40; Naco, 1,380; New York, 16,618; Nogales, 32,026; San Ysidro, 442; Tampa, 225; Ysleta, 183.	93,119
Strawberry.....do.....	El Paso, 7,319; New York, 15; Nogales, 2; San Ysidro, 5.	7,341
Sweetpotato.....do.....	Hawaii (all ports), 4,200.	4,200
Swiss chard.....do.....	El Paso, 11,451.	11,451
Tamarind bean pod.....do.....	Calexico, 33; El Paso, 775; New Orleans, 630; New York, 198,776; Nogales, 11; San Francisco, 80.	200,305
Tomato.....do.....	Boston, 42,247; Brownsville, 6,966; Buffalo, 22,300; Calexico, 8,829; Del Rio, 25; Douglas, 22,108; Eagle Pass, 39,166; El Paso, 220,530; Hidalgo, 716; Key West, 1,770,760; Laredo, 372,390; Los Angeles, 1,784,244; Mercedes, 9; Miami, 1,042,452; Naco, 4,645; New Orleans, 2,081,968; New York, 35,858,569; Nogales, 33,472,327; Presidio, 165; Puerto Rico (all ports), 2,850; Rio Grande City, 20; Roma, 88; San Francisco, 271,254; San Ysidro, 284; Tampa, 575,890; Ysleta, 1,041.	77,601,843
Turnip.....do.....	Calexico, 470; Douglas, 50; Eagle Pass, 20; El Paso, 254,356; Naco, 20; New York, 2,778; Nogales, 3,723; San Ysidro, 19; Ysleta, 524.	261,960
Vaccinium (cranberry, etc.):		
Frozen.....do.....	Boston, 833,470; New York, 2,664,879.	3,498,349
Natural.....do.....	Boston, 20,860; Chicago, 34,600; New York, 380,016; Philadelphia, 122,400; Port Huron, 124,600.	682,476
Water caltrop.....do.....	Hawaii (all ports), 3,440; New York, 960; Niagara Falls, 600; San Francisco, 6,100; Seattle, 400.	11,500
Waterchestnut.....do.....	Blaine, 385; Boston, 46,135; Buffalo, 86,968; Chicago, 70,500; Detroit, 25,500; Hawaii (all ports), 107,526; Los Angeles, 145,490; New York, 400,380; Niagara Falls, 129,046; Portal, 6,000; Portland, 16,020; San Francisco, 507,800; Seattle, 519,438.	2,061,188
Watercress.....do.....	Calexico, 37; Douglas, 433; Naco, 215; Nogales, 2,962.	3,647
Waterlily root.....do.....	New York, 55,618; Portland, 1,300; San Francisco, 4,600; Seattle, 10,462.	71,980
Watermelon.....do.....	Calexico, 2,264; Douglas, 1,860; Key West, 3,120; Mercedes, 75; Miami, 5,850; Naco, 445; New Orleans, 700; New York, 98,420; Nogales, 307,207; Rio Grande City, 92; Roma, 603; San Ysidro, 273.	420,909
Yam.....do.....	Hawaii (all ports), 35,411.	35,411
Yam bean root.....do.....	El Paso, 580; Hawaii (all ports), 1,900; Laredo, 1,420; Los Angeles, 1,900; Niagara Falls, 400; Nogales, 9; San Francisco, 22,900.	29,109



**PLANTS AND PLANT PRODUCTS ENTERED FOR EXPORTATION OR FOR  
TRANSPORTATION AND EXPORTATION**

In addition to the regulated imports for consumption entry recorded in tables 22 to 34, this Bureau supervised the entry under permit, either for exportation or for transportation and exportation, of considerable quantities of plants and plant products, as follows: Flower bulbs, corms, and tubers, 416,682; fruit trees, 1,596 and 2 bales<sup>1</sup> and 1 box<sup>1</sup>; cacti, 41,119; orchids, 308 and 2 cases<sup>1</sup>; miscellaneous plants, 38,644, 11 bales<sup>1</sup> and 16 cases<sup>1</sup>; sugarcane, 406 pounds; miscellaneous seeds, 2,418 pounds and 2 cases<sup>1</sup>; apples, 11,450 pounds; beans, string, 4,515 pounds; cauliflower, 3,306 pounds; chestnuts, 460 pounds; cucumbers, 1,000 pounds; eggplants, 55,300 pounds; garlic, 2,141,983 pounds; ginger root, 280 pounds; grapes, 142,490 pounds; grapes, hothouse, 538 pounds; grapefruit, 10,317,288 pounds; lemons, 2,104,305 pounds; lily bulbs, edible, 600 pounds; melons, 17,500 pounds; nectarines, 1,500 pounds; onions, 9,024,898 pounds; oranges, 2,747,727 pounds; peas, 446,708 pounds; peppers, 67,510 pounds; pineapples, 113,543 crates; plums, 9,910 pounds; potatoes, 566,411 pounds; tangerines, 4,000 pounds; tomatoes, 18,319,944 pounds; waterchestnuts, 1,052 pounds; bagging, 2,134 bales; broomcorn, 7,218 bales; shelled corn, 5,129,234 pounds; cotton, 112,284 bales, including 1,816 bales of linters, and 109 packages; cotton waste, 2,971 bales and 1 package; cottonseed, 883,945 pounds; cottonseed cake, 1,140,264 pounds; cottonseed meal, 352,738 pounds; seed or paddy rice, 1,975 pounds; rice straw, 98 bales; and wheat, 7,395 pounds.

**MARITIME-PORT INSPECTION****SHIP INSPECTION**

Ships from foreign countries and from Hawaii and Puerto Rico are inspected promptly upon arrival for the presence of prohibited or restricted plant material.

The inspection at ports in California, Florida, Hawaii, and at certain ports in Puerto Rico has been performed by State and Territorial officials serving as collaborators of the Bureau of Entomology and Plant Quarantine.

A record by ports of the ship inspection appears in table 35.

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<sup>1</sup> Information as to exact quantity not available.

TABLE 35.—*Number of ships inspected, fiscal year 1935*

Port	From foreign ports											
	Direct			Via United States ports			Via Hawaii			Via Puerto Rico		
	Arrived	Inspected	With contra-band	Arrived	Inspected	With contra-band	Arrived	Inspected	With contra-band	Arrived	Inspected	With contra-band
Baltimore.....	489	478	197	700	686	322	---	---	---	---	---	---
Bellingham.....	72	69	21	---	---	---	---	---	---	---	---	---
Boston.....	1,265	1,263	606	267	265	136	---	---	---	1	1	0
Brunswick 1.....	4	3	2	---	---	---	---	---	---	---	---	---
Buffalo.....	4	4	0	---	---	---	---	---	---	---	---	---
Charleston.....	146	146	115	133	129	62	---	---	---	---	---	---
Chicago.....	2	2	2	---	---	---	---	---	---	---	---	---
Corpus Christi 2.....	17	17	12	81	81	40	---	---	---	---	---	---
Detroit.....	12	12	11	6	1	0	---	---	---	---	---	---
Galveston.....	240	236	83	486	483	231	---	---	---	---	---	---
Gulfport 3.....	13	12	10	111	71	34	---	---	---	---	---	---
Honolulu 4.....	205	205	107	---	---	---	---	---	---	---	---	---
Houston.....	317	316	230	437	436	211	---	---	---	---	---	---
Jacksonville 4.....	160	160	39	135	135	0	---	---	---	2	2	0
Key West 4.....	337	334	118	12	12	2	---	---	---	---	---	---
Miami 4.....	766	766	200	15	15	0	---	---	---	---	---	---
Mobile.....	156	155	90	368	368	225	---	---	---	---	---	---
New Orleans.....	1,083	1,083	588	476	476	304	4	4	2	---	---	---
Newport News 4.....	58	19	18	370	20	19	---	---	---	---	---	---
New York.....	3,562	3,515	2,746	877	725	417	1	0	0	130	130	121
Norfolk.....	261	259	115	736	674	205	---	---	---	---	---	---
Pensacola 4.....	57	57	17	210	210	5	---	---	---	---	---	---
Philadelphia.....	679	679	502	920	919	613	---	---	---	---	---	---
Port Arthur.....	300	298	160	294	289	96	1	1	0	---	---	---
Portland, Oreg.....	111	111	78	386	386	208	---	---	---	---	---	---
Puerto Rico (all ports).....	1,091	1,080	537	---	---	---	---	---	---	---	---	---
San Diego 4.....	1,281	1,281	18	72	72	0	---	---	---	---	---	---
San Francisco 4.....	421	421	37	790	790	44	94	94	57	---	---	---
San Pedro 4.....	1,333	1,333	556	606	606	102	98	98	54	6	6	2
Savannah.....	82	82	66	208	208	109	---	---	---	---	---	---
Seattle.....	1,436	1,333	187	336	336	186	5	5	1	---	---	---
Tampa 4.....	258	258	47	309	309	1	---	---	---	---	---	---
West Palm Beach 4.....	66	66	0	---	---	---	---	---	---	---	---	---
Total.....	16,284	16,053	7,515	9,357	8,718	3,584	203	202	114	139	139	123

<sup>1</sup> Work handled by inspector stationed at Savannah, Ga.<sup>2</sup> This port closed Dec. 1, 1934.<sup>3</sup> Work handled by inspectors stationed at Mobile, Ala.<sup>4</sup> Collaborators stationed at these ports.

NOTE.—The foreign ship arrivals do not in all cases agree with customs figures. Foreign ships may put in for bunkers and be inspected by inspectors of the Bureau of Entomology and Plant Quarantine but not entered by customs. On the other hand, ships entered at certain small ports are included in customs records but not in this report.



TABLE 35.—*Number of ships inspected, fiscal year 1935—Continued*

Port	From Hawaii						From Puerto Rico						From United States ports via Panama Canal		
	Direct			Via United States ports			Direct			Via United States ports			Arrived	In-spected	With contra-band
	Arrived	In-spected	With contra-band	Arrived	In-spected	With contra-band	Arrived	In-spected	With contra-band	Arrived	In-spected	With contra-band			
Baltimore.....	1	1	0	18	18	0	15	15	3	32	32	8	214	211	5
Bellingham.....	2	2	0	11	11	0	11	11	5	1	0	0	239	239	1
Boston.....															
Brunswick 1.....															
Buttalo.....															
Charleston.....							8	8	2	15	14	5	64	64	3
Chicago.....															
Corpus Christi 2.....										3	3	0	9	9	0
Detroit.....							11	11	4	4	4	1	13	13	1
Galveston.....															
Gulfport 3.....										2	2	1	119	119	0
Honolulu 4.....							6	6	2	20	20	8	80	80	11
Houston.....	3	3	2	4	4	0	11	11	2	8	8	0	53	53	1
Jacksonville 4.....															
Key West 4.....															
Miami 4.....							3	3	1	1	1		3	3	0
Mobile.....							9	9	8	38	38	11	67	67	1
New Orleans.....							22	22	2	48	48	1	62	62	4
Newport News 4.....	12	12	7	7	7	0									0
New York.....							135	134	103	23	12	6	312	212	6
Norfolk.....	4	4	2	43	34	6									0
Pensacola 4.....							3	3	0	19	19	2	76	76	0
Philadelphia.....	1	1	1	22	22	4	56	56	37	10	10	1	311	310	15
Port Arthur.....	1	1	1	3	3	0	4	4	3	2	2	1	32	31	0
Portland, Oreg.....													395	395	0
Puerto Rico (all ports).....	2	2	0	7	7	0									0
San Diego.....	116	116	11										22	22	11
San Francisco.....	160	160	24	24	24	8							162	162	23
San Pedro 4.....	94	94	14	26	26	2							583	583	3
Savannah.....							12	12	6	4	3	1	945	944	91
Seattle.....													38	38	1
Tampa.....	10	10	1	13	13	1							168	168	2
West Palm Beach 4.....							28	28	3	2	2	0			
Total.....	406	406	63	186	177	21	340	339	182	239	226	39	3,977	3,870	179

## CARGO INSPECTION

All importations of plants and plant products subject to plant-quarantine restrictions were inspected at the port of entry or the port of first arrival. A record of such importations by ports appears in table 36.

In addition to the importation credited to the Mexican border ports, there were several thousand importations that were so small that no duty was assessed by customs and no entry made. All these small lots, however, were inspected. It was also necessary to devote considerable time at several ports to the inspection of miscellaneous cargoes in order to establish the true status of the importation and to supervise the cleaning of shipments containing prohibited packing material or contaminated with objectionable material, such as soil.

TABLE 36.—*Inspection of shipments of plants and plant products offered for entry, fiscal year 1935*

Port	Shipments inspected and entered under permit	Shipments refused entry	Port	Shipments inspected and entered under permit	Shipments refused entry
	Number	Number		Number	Number
Baltimore.....	282	1	Mobile.....	81	0
Bellingham.....	71	0	Naco.....	11	0
Blaine.....	65	1	New Orleans.....	1,801	3
Boston.....	1,490	1	New York.....	11,901	152
Brownsville.....	981	0	Nogales.....	3,502	3
Buffalo.....	541	0	Norfolk.....	162	0
Calexico.....	208	0	Pensacola <sup>2</sup> .....	0	0
Charleston.....	147	2	Philadelphia.....	578	0
Chicago.....	31	0	Port Arthur.....	3	0
Corpus Christi <sup>1</sup> .....	1	0	Port Huron <sup>2</sup> .....	72	0
Del Rio.....	11	0	Portland, Oreg.....	80	2
Detroit.....	526	6	Presidio.....	240	0
Douglas.....	26	0	Puerto Rico (all ports).....	481	1
Eagle Pass.....	1,163	0	Rio Grande City.....	41	0
El Paso.....	5,668	0	Roma.....	82	0
Galveston.....	224	0	San Diego <sup>2</sup> .....	6	0
Hidalgo.....	1,585	2	San Francisco <sup>2</sup> .....	933	34
Honolulu <sup>2</sup> .....	449	48	San Pedro <sup>2</sup> .....	606	0
Houston.....	167	0	San Ysidro.....	130	1
Jacksonville <sup>2</sup> .....	79	0	Sasabe <sup>3</sup> .....	2	0
Key West <sup>2</sup> .....	569	0	Savannah.....	30	1
Laredo.....	3,929	14	Seattle.....	613	4
Los Angeles <sup>2</sup> .....	7	0	Tampa <sup>2</sup> .....	863	0
Mercedes.....	65	0			
Miami <sup>2</sup> .....	189	0	Total.....	40,692	276

<sup>1</sup> Port closed Dec. 1, 1934.<sup>2</sup> Collaborators stationed at these ports.<sup>3</sup> Port closed June 15, 1935.

## DISINFECTION

Disinfection is required of certain commodities as a condition of entry and of other commodities when inspection reveals the presence of injurious insects or plant diseases. During the fiscal year the following plant material was treated under the supervision of inspectors of this Bureau: Cotton, 93,184 bales; cotton linters, 32,256 bales; cotton waste, 64,571 bales; cotton samples, 946; bagging, 327 bales; cottonseed hull fiber, 153 bales; broomcorn, 50,038 bales; rice fiber, 4,313 bales; grapes, 156,542 barrels and 9,314 half barrels and kegs; chestnuts, 5,097 cases and barrels; tree seeds, 36 cases, 13 bags, and 325 packages; miscellaneous plants, 378 lots; narcissus bulbs imported under special permit, 753,958; and bulbous iris, 594,529.

In addition to the above, there were treated at the inspection house at Washington, D. C., various shipments of plant material and cotton samples as shown in table 41.

## AIRPLANE INSPECTION

Three thousand one hundred and fifty airplanes arriving from foreign countries and Hawaii were inspected during the fiscal year. These airplanes arrived at the following 15 ports of entry: Calexico, Los Angeles, San Diego,



and San Francisco, Calif.; Nogales, Ariz.; Miami, Tampa, and West Palm Beach, Fla.; San Juan, P. R.; Brownsville, Eagle Pass, El Paso, Laredo, and Presidio, Tex.; and Seattle, Wash. A total of 918 interceptions of prohibited and restricted plant material were taken from 537 airplanes.

#### FOREIGN PARCEL-POST INSPECTION

Through cooperation with customs and post-office officials, mail packages from foreign countries which are found to contain plants or plant products are referred to inspectors of this Bureau for examination. Such packages arriving at ports of entry where no plant quarantine inspectors are stationed are forwarded by the postal officials to the nearest port where inspection can be made.

Table 37 indicates by ports the number and disposition of foreign mail packages inspected during the fiscal year.

Table 37 includes shamrocks, which are permitted entry through the mails provided they are free from soil. It has not been the policy to include such importations in the annual reports for the past few years but, inasmuch as they represent a considerable amount of work, it seems desirable that they now be shown. Of the number of packages listed above as inspected, the following represent shamrocks: Boston, 8,550; Chicago, 4,885; Detroit, 640; Los Angeles, 388; New York, 31,509; Philadelphia, 3,581; St. Paul, 561; San Francisco, 748; and Seattle, 128.

TABLE 37.—*Foreign parcel-post packages inspected, fiscal year 1935*

Port	Inspected	Refused entry (entire or in part)	Diverted to Washington	Port	Inspected	Refused entry (entire or in part)	Diverted to Washington
	Number	Number	Number		Number	Number	Number
Atlanta <sup>1</sup> .....	42	3	18	Naco.....	58	0	0
Baltimore.....	2,400	64	226	New Orleans.....	237	20	99
Boston.....	10,306	87	806	New York.....	45,908	1,536	2,401
Brownsville.....	595	13	17	Nogales.....	423	23	5
Buffalo.....	67	25	7	Philadelphia.....	10,314	324	733
Chicago.....	8,830	491	270	Portland, Oreg. <sup>3</sup> .....	18	6	1
Detroit.....	4,351	161	257	Puerto Rico (all ports).....	3	1	0
Eagle Pass.....	335	2	2	St. Paul <sup>1</sup> .....	8,174	156	158
El Paso.....	884	157	26	San Diego <sup>1 4</sup> .....	70	0	0
Honolulu <sup>1</sup> .....	441	19	0	San Francisco <sup>1</sup> .....	5,428	224	0
Jacksonville <sup>1</sup> .....	560	75	90	Seattle.....	1,634	92	2
Laredo.....	629	42	3	Washington, D. C. ....	753	13	-----
Los Angeles <sup>1 2</sup> .....	4,949	148	0				
Miami <sup>1</sup> .....	40	38	1				
Mobile.....	1	1	0	* Total.....	107,450	3,721	5,122

<sup>1</sup> Collaborators are stationed at these ports.

<sup>2</sup> 394 packages diverted to San Francisco for treatment.

<sup>3</sup> 8 packages diverted to Seattle for treatment.

<sup>4</sup> 1 package diverted to San Francisco for treatment.

#### MEXICAN-BORDER SERVICE

The increase in the movement of railway cars from Mexico which took place during the fiscal year 1934 continued during the fiscal year 1935. A total of 30,736 freight cars were inspected in the Mexican railway yards. Of this number 28,422 entered the United States and 6,841 were fumigated as a condition of entry. This represents an increase of 74+ percent in the number of cars inspected, 73+ percent in the number of cars that entered, and 26+ percent in the number of cars fumigated over the fiscal year 1934. Of the total number inspected, 1,507 cars were found to be contaminated with cottonseed. Cleaning was required as a condition of entry. The usual fee of \$4 was charged for each car fumigated and all fees collected were covered into the Treasury as miscellaneous receipts. A summary of the railway-car inspection and fumigation is given in table 38. In addition to the freight cars listed in table 37, 4,368 Pullman and passenger coaches crossed the border and were inspected.

TABLE 38.—*Inspection and fumigation of railway cars crossing the border from Mexico, fiscal year 1935*

Port	Cars inspected	Cars with cotton-seed	Cars entered	Cars fumigated	Fees collected
	Number	Number	Number	Number	Dollars
Brownsville.....	693	24	656	16	64
Douglas.....	899	18	899	34	136
Eagle Pass.....	2,262	209	1,938	903	3,700
El Paso.....	6,976	354	5,829	<sup>1</sup> 1,245	4,448
Laredo.....	12,567	703	12,032	3,417	13,868
Naco.....	717	29	716	14	56
Nogales.....	6,388	132	6,118	1,131	4,600
Presidio.....	234	38	234	81	324
Total.....	30,736	1,507	28,422	6,841	<sup>2</sup> 27,196

<sup>1</sup> Includes 31 cars not from Mexico.<sup>2</sup> The apparent discrepancy in fees collected and the number of cars fumigated may be explained by the fact that it is customary for the railroads to purchase fumigation coupons in advance.

Plant-quarantine inspectors at Mexican border ports take an active part, in cooperation with the customs service, in the inspection of vehicles, baggage, personal effects, and express packages from Mexico. A total of 205,835 pieces of baggage and between 3,500,000 and 4,000,000 vehicles, including 56,233 street cars, were inspected. This inspection resulted in the interception of a considerable quantity of prohibited and restricted plant material. A record of such interceptions appears in table 43.

#### INSPECTION IN PUERTO RICO AND HAWAII

In addition to the enforcement of the foreign-plant quarantines and regulatory orders, the inspectors stationed in Puerto Rico also enforce the provisions of Quarantine No. 58. This involves the inspection of fruits and vegetables in the fields, in packing houses, and on the docks, and all shipments of such products moving to the mainland have been certified as free from pests.

Inspection is also made of parcel-post packages originating on the island and destined for points in continental United States. A total of 738 packages were inspected and 60 were found to contain prohibited plant material and were returned to the sender.

A record by months of the amounts of fruits and vegetables inspected and certified for shipment to the mainland appears in table 39.

Inspectors stationed in Hawaii are engaged principally with the enforcement of Quarantine No. 13 on account of the Mediterranean fruit fly and the melon fly. Inspections were made in the fields, in packing sheds, and on the docks of such fruits and vegetables as are permitted to move to the mainland.

Inspection was also made of parcel-post packages originating in the Hawaiian Islands and destined for points on the mainland. A total of 89,843 packages were opened and examined, 99,344 packages were inspected without being opened, and 89 packages were found to contain prohibited plant material.

As an accommodation to travelers between Hawaii and the mainland baggage is inspected and sealed in Honolulu. During the fiscal year 2,543 pieces of baggage were inspected and sealed under this arrangement.

In both Hawaii and Puerto Rico valuable assistance was rendered by insular plant-quarantine inspectors serving as collaborators.

A record of the amounts of fruits and vegetables inspected and certified for shipment from Hawaii to the mainland appears in table 40.



TABLE 39.—Summary of shipments of fruits and vegetables moving from Puerto Rico to the mainland, inspected and certified under Quarantine No. 58, fiscal year 1935

Item	July	August	September	October	November	December	January	February	March	April	May	June	Total
Arrowroot..... pounds.								60					60
Avocados..... do.		60	50										110
Bananas..... bunches.	91	46	89	206	57	58	5		6			65	630
Breadfruit..... pounds.	1, 140	4, 000	6, 050	6, 700	2, 400	4, 320	1, 220	640	4, 500	2, 460	1, 140	1, 480	36, 050
Cabbage..... do.									7, 320	6, 120			13, 440
Celery root..... do.			35	35	125					90	180	540	1, 005
Chayotes..... do.	2, 115	2, 255	3, 615	4, 545	4, 895	11, 415	4, 420	3, 960	6, 765	3, 175	950	3, 880	51, 990
Citrons..... do.					60				480				540
Cucumbers..... do.			125	120	1, 800	35, 380	870, 230	1, 208, 350	506, 550	295, 370	5, 400		2, 923, 230
Cucumbers (Angola)..... do.					260	30						140	585
Dashens..... do.	2, 730	3, 620	3, 650	6, 520	10, 255	23, 640	12, 640	25, 475	50, 445	69, 055	42, 515	80, 540	331, 085
Eggplants..... do.				240		2, 260	1, 740	1, 740	5, 400	4, 100	1, 980	180	17, 980
Ginger root..... do.	12, 290	9, 220	8, 015	11, 630	13, 200	2, 955	5, 290	7, 850	4, 080	7, 520	12, 950	790	95, 790
Grapefruit..... do.	1, 147, 230	829, 800	5, 066, 820	2, 671, 470	326, 520	220, 140	58, 200	135, 540	441, 300	2, 321, 640	1, 565, 010	4, 356, 540	19, 140, 600
Lemons..... do.	2, 070	810	900			1, 980							19, 140, 600
Leranes..... do.					340		260		160	180			6, 210
Lima beans..... do.			35										1, 060
Limes..... do.	11, 470	8, 270	14, 870	29, 070	17, 730	7, 470	8, 190	5, 130	2, 970	1, 710	4, 050	9, 270	120, 200
Mixed (fruits and vegetables)..... do.	60			270	540	7, 120	2, 280	3, 150	1, 390	1, 380	810	1, 770	18, 770
Onions..... do.									4, 320				4, 440
Oranges..... do.	4, 320		34, 650	203, 400	571, 435	328, 860	245, 520	21, 420	67, 770	4, 770	450	180	1, 482, 775
Oranges (sour)..... do.				180	900	2, 430	90	4, 500			90		8, 100
Papayas..... do.						3, 010	1, 765	650	360	480	2, 360		12, 530
Parsley..... do.	1, 225	780	390	665	540	880	700	2, 360	1, 650	1, 675	1, 250	1, 910	12, 084
Peas (garden)..... do.	355	740	824		720			650	3, 440	250			6, 850
Peppers..... do.				225					35, 410	35, 410	14, 140	4, 315	149, 845
Peppers (small)..... do.	630	958	500	695	730	580	25, 005	43, 825	26, 425	2, 280	1, 065	740	103, 513
Pigeon peas..... do.					12, 425	52, 610	45, 525	47, 560	1, 045	4, 410			226, 103
Pineapples..... crates.	10, 182	13, 362	5, 046	1, 233	1, 050	966	1, 985	63, 870	63, 870	84, 368	99, 432	56, 433	368, 291
Pineapples..... half crates.	2, 141	5, 554	3, 488	1, 286	1, 701	2, 431	1, 743	15, 125	69, 109	12, 763	8, 180	13, 560	69, 910
Plantains..... pounds.						120		4, 958	12, 105	10, 300			31, 240
Potatoes..... do.								4, 800	16, 240	12, 763			31, 240
Pumpkins..... do.	11, 560	15, 985	17, 905	18, 280	19, 870	30, 880	8, 915	22, 850	24, 650	32, 365	15, 890	17, 795	268, 945
Queenpas..... do.	1, 500	6, 830	2, 840	560			8, 380				60		268, 945
Squash..... do.						5, 800	33, 290	56, 400	30, 740	840			127, 040
String beans..... do.						5, 000	53, 275	17, 895	22, 330	9, 275			107, 775
Sweet corn..... do.					300		180						480
Tamarinds..... do.	540	120			5, 580						1, 130	280	2, 070
Tangerines..... do.								3, 335	17, 380	16, 400	1, 325		5, 580
Tomatoes..... do.						300	2, 080						38, 440
Watermelons..... do.						78, 830	33, 085	31, 550	26, 115	14, 270	23, 420	10, 800	2, 380
Yams..... do.				25, 645	84, 215								335, 900
Yuca..... do.						40							40
Certificates.....	164	152	242	239	147	198	214	229	279	238	283	401	2, 706

TABLE 40.—*Fruits and vegetables inspected and certified for shipment from Hawaii to the mainland, fiscal year 1935*

Month	Bananas	Pine-apples	Taro	Ginger root	Swamp cabbage	Pota-toes	Water-nuts	Papaya (proc-essed)
	<i>Bunches</i>	<i>Crates</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
July.....	4,535	1,872	—	2,287	—	—	—	—
August.....	8,910	4,030	8,100	9,585	—	—	—	—
September.....	8,517	2,319	7,449	10,444	—	—	—	—
October.....	11,099	4,817	6,940	13,745	—	—	—	—
November.....	10,899	2,274	1,195	15,665	—	—	—	—
December.....	10,543	4,717	1,540	18,900	—	—	—	—
January.....	5,883	2,196	630	2,862	140	7,000	—	—
February.....	7,429	3,581	1,275	12,450	315	351,965	—	—
March.....	7,298	5,231	700	3,650	350	450,429	—	—
April.....	5,820	4,627	1,650	6,674	1,240	102,154	—	—
May.....	6,594	4,496	400	5,015	1,440	160	165	15
June.....	6,065	4,778	3,310	10,240	2,420	—	—	—
Total.....	93,592	44,938	33,189	111,517	5,905	911,708	165	15

Month	Avoca-do (frozen)	Avocado pulp (frozen)	Coco-nuts	Pod-ded peas	Yam bean roots	Yams	Lily roots <sup>1</sup>	Bur-dock roots	Permits issued
	<i>Pounds</i>	<i>Pounds</i>	<i>Number</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Number</i>
July.....	—	—	19	—	—	—	19,500	—	92
August.....	—	—	25	—	—	—	14,975	—	184
September.....	—	50	4,447	—	—	—	24,740	—	146
October.....	—	465	6,850	—	—	—	24,190	45	199
November.....	—	2,100	529	—	—	1,080	28,200	—	175
December.....	—	—	14,209	—	—	3,315	42,840	—	216
January.....	—	—	36	125	620	1,175	23,500	—	131
February.....	—	—	4,943	—	130	—	21,760	—	189
March.....	—	—	2,415	—	145	—	24,690	—	168
April.....	—	—	140	—	220	300	21,500	—	155
May.....	15	—	38	—	160	—	7,650	—	150
une.....	—	—	163	—	—	250	—	—	178
Total.....	15	2,615	33,814	125	1,275	6,120	253,545	45	1,983

<sup>1</sup> The edible root (*Nelumbium nelumbo*) is also well known to the trade as lotus root.

## INSPECTION OF SPECIAL-PERMIT AND DEPARTMENTAL PLANT MATERIAL

As in previous years, all plants imported under special permit have been inspected at ports of entry designated for such material. A tabular record of special-permit importations is presented in table 25. The majority of such special-permit importations have been, as in former years, inspected at Washington, D. C., and these, together with departmental importations and distributions from Washington, including domestic plants entering and leaving the District of Columbia, are inspected and certified for shipment at the Department inspection house, in the nursery, or in freight, express, or post offices. A summary of the inspections made at Washington, D. C., is given in table 41.



TABLE 41.—*Summary of plants and plant products offered for inspection in the District of Columbia, fiscal year 1935*

Material inspected	For- eign	Domes- tic	Fumi- gated	Other- wise treated	In- fested with insects	In- fected with diseases
Lots of seeds (departmental).....	5,550	3,863	4,855	501	892	284
Plants, cuttings, bulbs, roots, rhizomes, etc. (depart- mental).....	13,281	71,620	15,610	7,366	1,369	1,207
Miscellaneous unclassified material, other than plants and seeds (departmental).....	206	89	74	22	4	2
Shipments of plants under regulation 14, Quarantine No. 37 (commercial).....	1,179	-----	250	94	344	302
Shipments of plants and plant products under regula- tions 3 and 15, Quarantine No. 37 (commercial).....	721	-----	401	54	66	51
Containers of domestic plants other than depart- mental (mail, express, freight, and truck).....	-----	8,900	-----	-----	-----	-----
Shipments of plants by private individuals.....	-----	2,910	10	89	99	45
Interceptions of plants and plant products referred to Washington, D. C.....	1,263	-----	517	143	105	39
Cotton samples referred to Washington, D. C.....	17,417	-----	17,417	-----	-----	-----

<sup>1</sup> Lots.

## INSPECTION OF PLANT-INTRODUCTION AND PROPAGATING GARDENS

As heretofore, plants grown and distributed by the Bureau of Plant Industry from its plant-introduction and propagating gardens were inspected and certified prior to shipment. Plants shipped from Mandan, N. Dak., Coconut Grove, Fla., and Chico, Calif., were inspected by officials of the States concerned, cooperating with this Bureau. Those distributed from Savannah, Ga., were examined by an inspector of this Bureau. Table 42 indicates the number of plants inspected and certified for distribution.

TABLE 42.—*Plants, budsticks, cuttings, tubers, roots, and shipments of seeds examined for distribution from plant-introduction and propagating gardens, fiscal year 1935*

Station	Plants	Bud- sticks, cuttings, tubers, and roots	Ship- ments of seeds	Station	Plants	Bud- sticks, cuttings, tubers, and roots	Ship- ments of seeds
	<i>Number</i>	<i>Number</i>	<i>Number</i>		<i>Number</i>	<i>Number</i>	<i>Number</i>
Bell, Md.....	48,952	1,806	-----	Mandan, N. Dak.....	312,887	-----	-----
Chico, Calif.....	9,317	538	81	Beltsville, Md.....	4,321	-----	-----
Coconut Grove, Fla.....	1,752	1,936	33	Total.....	387,838	30,984	11,289
Savannah, Ga.....	341	2,127	-----				
District of Colum- bia.....	10,268	24,577	11,175				

## INTERCEPTIONS OF PROHIBITED AND RESTRICTED PLANTS AND PLANT PRODUCTS

A record of the number of interceptions of prohibited and restricted plants and plant products appears in table 43. Many of these interceptions were found to harbor insect pests and plant diseases and many others, while showing no infestation or infection, must be considered potentially dangerous, as they came from countries where pests not present in this country are known to occur.

Interceptions made at bridges, ferries, and crossings at the Mexican and Canadian border ports have all been considered as having been taken from baggage.

TABLE 43.—*Number of interceptions of prohibited and restricted plants and plant products, fiscal year 1935*

Port	In baggage		In cargo		In mail		In quarters		In stores		Total	
	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted	Prohibited	Restricted
Baltimore.....	0	1	16	1	9	42	36	4	82	5	143	53
Bellingham.....	1	1					0	1	22	27	23	29
Blaine.....	543	976									543	976
Boston.....	66	148	4	1	22	92	10	4	5	0	107	245
Brownsville.....	3,230	300			0	30					3,230	330
Brunswick <sup>1</sup> .....							3	0			3	0
Buffalo.....	1	190			4	29					5	219
Calexico.....	2,044	81									2,044	81
Charleston.....	2	0					100	19	6	6	108	25
Chicago.....	1	0	10	0	223	310					234	310
Corpus Christi <sup>2</sup> .....							5	4	2	1	7	5
Del Rio.....	590	74									590	74
Detroit <sup>3</sup> .....	12	572	13	5	53	133					78	710
Douglas.....	537	107									537	107
Eagle Pass.....	1,537	184			1	1					1,538	185
El Paso.....	8,261	1,837			20	132					8,281	1,969
Fabens <sup>4</sup> .....	145	22									145	22
Galveston.....	3	6	2	2			62	5	20	1	87	14
Gulfport <sup>5</sup> .....							7	0	6	1	13	1
Hidalgo.....	1,209	79									1,209	79
Honolulu <sup>6</sup> .....	515	204	141	3	8	3			2	4	666	214
Houston.....	3	1					181	18	18	1	202	20
Jacksonville <sup>6</sup> .....	1	1			48	29	7	12	23	8	79	50
Key West <sup>6</sup> .....	134	341	9	7			2	42	9	8	154	368
Laredo.....	4,737	431			11	1					4,748	432
Los Angeles <sup>6</sup> .....	3	2	0	1	74	79			1	0	78	82
Mercedes.....	345	48									345	48
Miami <sup>6</sup> .....	402	902	9	3	8	32	130	563	26	34	575	1,534
Mobile.....	2	4	1	1			21	17	23	11	47	33
Naco.....	71	25									71	25
New Orleans.....	360	366	17	4	3	1	581	108	77	14	1,038	493
New York.....	1,523	1,778	289	211	309	1,540	282	123	104	12	2,507	3,664
Nogales.....	2,349	612			0	23					2,349	635
Norfolk.....			1	0			33	106	22	7	56	113
Pensacola <sup>6</sup> .....							18	6	19	3	37	9
Philadelphia.....	6	9	23	8	91	246	86	42	82	26	288	331
Port Arthur <sup>7</sup> .....	0	2	2	0			71	14	23	1	96	17
Port Huron <sup>6</sup> .....	0	73									0	73
Portland, Oreg.....	1	0	4	0	3	4			8	3	16	7
Presidio.....	225	38									225	38
Puerto Rico (all ports).....	42	66					4	5	1	0	47	71
Rio Grande City.....	48	11									48	11
Roma.....	275	55									275	55
St. Paul <sup>6</sup> .....					17	142					17	142
San Diego <sup>6</sup> .....	11	4					8	0	31	8	50	12
San Francisco <sup>6</sup> .....	181	21	25	3	26	13	123	50	84	11	439	98
San Pedro <sup>6</sup> .....	106	78	4	0			50	19	125	26	285	123
San Ysidro.....	4,636	1,041									4,636	1,041
Sasabe <sup>8</sup> .....	74	17									74	17
Savannah.....	1	0					108	10	21	4	130	14
Seattle.....	74	40	3	0	23	31	2	0	1	0	103	71
Tampa <sup>6</sup> .....	3	3	0	1			19	8	35	3	57	15
West Palm Beach <sup>6</sup> .....	0	2					0	11	0	1	0	14
Ysleta.....	372	22									372	22
Total.....	34,682	10,775	573	251	953	2,913	1,949	1,191	878	226	39,035	15,356

<sup>1</sup> Work handled by inspector stationed at Savannah, Ga.<sup>2</sup> Port closed Dec. 1, 1934.<sup>3</sup> Interceptions in baggage are recorded at 1 customs station only, and the number reported represents only part of the total for Detroit.<sup>4</sup> Port closed June 1, 1935.<sup>5</sup> Work handled by inspectors stationed at Mobile, Ala.<sup>6</sup> Collaborators stationed at these ports.<sup>7</sup> Includes interceptions made at Beaumont and Sabine, Tex., and Lake Charles, La.<sup>8</sup> Port closed June 15, 1935.



## PESTS INTERCEPTED

During the fiscal year the inspectors and collaborators of the Bureau collected from foreign plants and plant products insects belonging to 1,680 recognized species and others distributed among 1,488 genera and families, fungi and bacteria belonging to 280 recognized species, plant-parasitic nematodes belonging to 14 recognized species, and numbers of interceptions of diseases caused by fungi, bacteria, nematodes, or other agents that could be referred to family, genus, or other group only. Many of these interceptions were of considerable economic or scientific importance.

A total of 44,754 interceptions of insects and plant diseases were made during the fiscal year 1935. A summary of the interceptions appears in table 44.

TABLE 44.—*Number of interceptions of insects and plant diseases made during the fiscal year 1935*

Port	Cargo		Stores		Baggage		Quarters		Mail		Total	
	In-sects	Dis-eases	In-sects	Dis-eases	In-sects	Dis-eases	In-sects	Dis-eases	In-sects	Dis-eases	In-sects	Dis-eases
Baltimore.....	254	31	109	146	1	1	36	22	36	14	436	214
Bellingham.....	6	5	3	3	2	0	0	0	0	0	11	8
Blaine.....	5	4	0	0	7	2	0	0	0	0	12	6
Boston <sup>1</sup> .....	81	62	192	187	58	13	18	6	36	12	385	280
Brownsville.....	44	3	2	0	230	4	26	0	0	0	302	7
Buffalo.....	0	17	0	0	0	0	0	0	0	0	0	17
Calexico.....	0	0	0	0	30	1	0	0	0	0	30	1
Charleston.....	441	15	9	58	0	0	2	0	0	0	452	73
Chicago.....	1	4	0	1	0	1	0	1	15	6	16	13
Corpus Christi <sup>2</sup> .....	0	0	9	23	0	0	1	1	0	0	10	24
Del Rio.....	0	0	0	0	13	0	0	0	0	0	13	0
Detroit.....	42	49	3	7	1	0	0	0	19	31	65	87
Douglas.....	0	0	0	0	22	3	0	0	0	0	22	3
Eagle Pass.....	79	3	1	0	95	5	0	0	0	0	175	8
El Paso.....	133	39	1	1	208	123	0	0	5	2	347	165
Fabens <sup>3</sup> .....	0	0	0	0	4	1	0	0	0	0	4	1
Galveston.....	587	4	33	109	3	0	23	4	0	0	646	117
Hawaii.....	93	0	4	0	104	0	1	0	107	0	309	0
Hidalgo.....	8	4	0	0	39	9	0	0	0	0	47	13
Houston.....	20	4	55	174	1	0	13	1	0	0	89	179
Jacksonville <sup>4</sup> .....	9	0	20	85	0	0	3	0	5	7	37	92
Key West <sup>4</sup> .....	3	0	1	6	11	2	2	0	0	0	17	8
Laredo.....	730	16	1	0	134	1	0	0	0	0	865	17
Los Angeles <sup>4</sup> .....	2	0	0	0	1	0	0	0	12	0	15	0
Miami <sup>4</sup> .....	79	6	45	18	292	15	126	6	4	2	546	47
Mobile <sup>5</sup> .....	679	3	116	385	2	6	20	7	0	1	817	402
Naco.....	5	0	0	0	28	0	0	0	0	0	33	0
New Orleans.....	1,908	146	368	554	86	23	250	84	29	6	2,641	813
New York.....	6,824	2,907	3,573	1,398	1,853	640	764	143	247	172	13,261	5,260
Nogales.....	2,983	615	1	8	389	123	0	2	6	0	3,379	748
Norfolk.....	49	4	4	10	0	0	5	3	0	0	58	17
Pensacola <sup>4</sup> .....	0	0	34	80	0	0	13	0	0	0	47	80
Philadelphia.....	1,698	261	438	1,010	6	8	207	109	192	155	2,541	1,543
Port Arthur.....	12	1	45	135	0	0	14	3	0	0	71	139
Portland.....	5	3	2	2	7	0	0	0	2	0	16	5
Presidio.....	35	0	0	0	4	1	0	0	0	0	39	1
Rio Grande City.....	0	0	0	0	2	2	0	0	0	0	2	2
Roma.....	1	0	0	0	0	0	0	0	0	0	1	0
San Diego <sup>4</sup> .....	2	0	24	7	3	1	5	0	1	0	35	8
San Francisco <sup>4</sup> .....	553	40	181	54	285	9	199	3	285	8	1,503	114
San Juan.....	3	2	1	0	7	1	0	0	0	1	11	4
San Pedro <sup>4</sup> .....	247	4	193	55	83	4	43	1	0	0	566	64
San Ysidro.....	23	3	0	0	22	4	0	0	0	0	45	7
Sasabe <sup>6</sup> .....	0	0	6	0	0	0	0	0	0	0	6	0
Savannah.....	0	0	24	52	0	0	8	0	0	0	32	52
Seattle.....	260	65	59	26	75	21	109	30	46	60	549	202
Tampa <sup>4</sup> .....	19	11	16	74	2	1	4	0	0	0	41	86
Thayer.....	0	0	0	0	1	0	0	0	0	0	1	0
Washington, D. C.....	830	359	0	0	9	1	0	0	1,454	619	2,293	979
Ysleta.....	0	0	0	0	4	2	0	0	0	0	4	2
Miscellaneous.....	2	0	0	0	0	0	0	0	1	0	3	0
Total.....	18,755	4,660	5,573	4,668	4,124	1,028	1,892	426	2,502	1,096	32,846	11,908

<sup>1</sup> Includes interceptions at Providence, R. I.

<sup>2</sup> Closed Dec. 6, 1934.

<sup>3</sup> Closed June 1, 1935.

<sup>4</sup> Collaborators stationed at these ports.

<sup>5</sup> Includes interceptions at Gulfport, Miss.

<sup>6</sup> Closed June 15, 1935.

## CERTIFICATION FOR EXPORT

During the fiscal year 1935 a total of 6,907 shipments, representing 2,792,029 containers of plants and plant products, were inspected and certified for export to meet the sanitary requirements of foreign countries. While this represents a decrease of 315 in the number of shipments, there was an actual increase of 71,555 in the total number of containers certified over the fiscal year 1934.

Certificates were issued at 26 ports and covered 58 different commodities which were exported to 58 foreign countries. Some of the more important commodities inspected and certified were: Apples, 2,148 shipments, consisting of 1,255,142 boxes, 86,190 baskets, and 38,964 barrels; pears, 842 shipments, consisting of 508,341 boxes; potatoes, 1,126 shipments, consisting of 300,770 bags, 13,810 barrels, and 8,410 crates and boxes; oranges, 479 shipments, consisting of 294,597 boxes; grapefruit, 160 shipments, consisting of 24,005 boxes; miscellaneous fruits and vegetables, 1,190 shipments, consisting of 108,539 containers. The certification of apples and pears was conducted cooperatively with the Bureau of Agricultural Economics.









## REPORT OF THE CHIEF OF THE OFFICE OF EXPERIMENT STATIONS, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., September 1, 1935.*

HON. HENRY A. WALLACE.  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I transmit herewith a report of the Office of Experiment Stations for the fiscal year ended June 30, 1935.

Sincerely yours,

JAMES T. JARDINE, *Chief.*

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The Office of Experiment Stations, as required by law and executive authorization, administered Federal funds provided by the Hatch, Adams, Purnell, and supplementary acts for the support of experiment stations in the several States and in Alaska, Hawaii, and Puerto Rico. During the year ended June 30, 1935, these funds amounted to \$4,388,000 (\$90,000 to each State, \$15,000 to Alaska, \$28,000 to Hawaii, and \$25,000 to Puerto Rico) out of a total of about \$14,000,000 available to the stations from all sources.

The Office also sought to coordinate the work of the Department of Agriculture with that of the experiment stations in every practicable way; administered the Federal stations in Hawaii and Puerto Rico; prepared and published the usual annual report on the work and expenditures of the stations, as required by law; issued Experiment Station Record; and rendered various other special services to and for the experiment stations.

### INSPECTION AND CERTIFICATION OF STATIONS

Representatives of the Office visited all the State experiment stations and the Hawaii Station during the fiscal year to inquire into the use being made of the Federal funds and the methods of accounting for them. As a result of these visits and other contacts, all the stations were certified as qualified to receive the funds provided for them by the Federal acts during the ensuing year. The representatives of the Office also had opportunity to inform themselves more fully regarding station work supported by other than Federal funds, amounting to nearly \$10,000,000 and derived from State appropriations, endowments, emergency allotments, sales of products, and other miscellaneous sources, and to aid in coordinating the work of the stations with that of the Department and the various relief and adjustment activities of the Government.

### STATION PROJECTS AND PROGRAMS

As in previous years, an important feature of the work of the Office was the critical examination by Office specialists, assisted in many cases by other specialists of the Department, of research programs and projects submitted by the stations for support by Federal funds and for research to be conducted in cooperation with the Department. These programs and projects covered a wide field of activity.

During the year the Office examined 80 new and revised Adams fund projects and 344 new and revised Purnell fund projects submitted to it by the stations for approval, disapproval, or amendment, as required by executive ruling and agreed to by common consent. In passing upon these projects it had the

assistance of specialists of other bureaus of the Department with special reference to their adequacy and their place in coordinated plans for the solution of some of the larger or more urgent rural problems.

In addition to the Adams and Purnell projects, some 5,000 other projects supported by Hatch, State, and other funds were examined by the Office with reference to progress, outlook, cost, possible improvement, and their place in a large coordinated plan of research.

The station projects now active, totaling about 7,000, provide for research in almost every phase of farming and rural living, including land use and conservation; crop adjustment; economical production, distribution, marketing, and use of plant and animal products; improvement of the quality of such products; protection against animal and plant diseases, insects, and other pests; tenancy, taxation, and other matters affecting the efficiency of farm-business management; and the betterment of the rural home and rural life. Increasing emphasis was given to efficient and remunerative production and the economic and social aspects of rural life. The compilation of a classified list of these projects was continued.

The Office was especially active during the year in mobilizing the results of station work in support of larger national and regional undertakings, as the germ-plasm survey, for example. The stations took part to an increasing extent in such activities, 600 or more of their personnel being concerned. The resulting diversion of many of these workers from previous duties made the problem of readjustment somewhat difficult and slowed up the program of certain kinds of fundamental research.

### COORDINATION AND COOPERATION

The Chief of the Office and members of the staff were especially active during the year, with the cooperation of other specialists of the Department and the State stations, in efforts to plan and coordinate Department and station research and to use the resulting information in support of the adjustment and relief policies of the Government, and to secure orderly and efficient dissemination of the information essential for this purpose. Various interbureau committee and regional conferences for this purpose were organized in addition to those already in existence, the Office acting as heretofore as intermediary in most of this work.

The substantial progress which is being made in coordinating agricultural research is reflected in the fact that of the approximately 7,000 projects under investigation in agriculture and home economics at the stations during the year, a large proportion dealing with the more urgent rural problems, especially those concerned with recovery measures, were carried on in cooperation with the Department. The Office examined and recorded 798 new or revised cooperative agreements between bureaus of the Department and the experiment stations, representing 734 major research undertakings. All of the 50 State stations and all but 1 of the research bureaus of the Department had formal cooperative agreements of some kind, besides a large number of informal cooperative activities. Numerous cooperative undertakings organized on an emergency basis as parts of the national recovery program were again participated in by practically all the stations and Department bureaus. An outstanding and typical example of coordination and cooperation on a large scale was the study of adjustments in farming by regions and type of farming areas from the standpoint of agricultural adjustment and planning, which was organized and participated in by 3 major agencies of the Department and 48 States. Another outstanding example of regional cooperation was the cotton-research program, which coordinated the activities of the Department and the major cotton-producing States. Many others might be mentioned.

### EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PUERTO RICO

There was little change in the status of the experiment stations in Alaska, Hawaii, and Puerto Rico during the year.

#### ALASKA STATION

The Alaska Station, under the jurisdiction of the Alaska Agricultural College and School of Mines, again received the annual appropriation of \$15,000 provided by extension of the Hatch Act to the Territory in 1929.



The station operates on budgets and projects approved by the Office, but otherwise functions administratively in much the same way as do the State experiment stations. As heretofore the work of the station was concerned mainly with the possibilities of plant and animal production and dairying in and around Fairbanks, in the Tanana Valley, and Matanuska, in the Matanuska Valley. G. W. Gasser again served as director of the station, with headquarters at College (near Fairbanks), Alaska.

The Office continued to disseminate, by publications and correspondence, information regarding agricultural possibilities and suitable crops and cultural practices in Alaska, for which there is a considerable demand, particularly in connection with the Government land settlement in the Matanuska Valley.

#### HAWAII STATION

The Federal experiment station in Hawaii, associated with the University of Hawaii, at Honolulu, continued under the direction of J. M. Westgate, who, however, was succeeded at the close of the year by O. C. Magistad.

The work of the station was not changed in any essential particular, the main purpose being, as heretofore, to develop a more diversified and self-sustaining agriculture. Helpful relations with the experiment stations maintained by the sugar and pineapple industries of the island were continued.

Representative examples of progress in work are further perfection and extension of the Mitscherlich soil fertility test; grading, curing, and storing macadamia nuts; improvement of coffee culture; use of coffee pulp; range and pasture grasses and forage crops; nutritive value of Hawaiian food products; light and egg production; housing of poultry; potato culture; feeding value of molasses; and tropical fruits.

The total income of the station for the fiscal year 1935 was \$91,977, as compared with \$86,270 for the previous year. The station had \$15,000 from the Hatch fund, \$13,000 from the Adams fund, \$32,977 from direct appropriation through the Department of Agriculture, and \$31,000 from territorial and university funds.

#### PUERTO RICO STATION

Atherton Lee succeeded T. B. McClelland as director of the Puerto Rico Station at Mayaguez at the beginning of the year.

Continued success attended efforts to correlate the work of this station with that of the Insular Government Station associated with the College of Agriculture of the University of Puerto Rico, and to develop the station as an outpost for certain lines of tropical research of special interest to the Federal Department of Agriculture.

The leading features of the station work at Mayaguez, as in previous years, were the development and introduction of improved sugarcane varieties, coffee fertilizing and cultural practices, control of animal parasites, and general service in aid of the establishment of a more self-sustaining agriculture in the island.

The Federal appropriation for this station for the fiscal year was only \$35,959 as compared with \$41,860 for the previous year. The Insular Station, however, received grants under the Puerto Rico Act of March 4, 1931, in the amount of \$25,000. In addition this station received from the Insular Government and other sources \$111,328.

In accordance with the provisions of the Puerto Rico Act of 1931 special effort was made to develop and carry forward a coordinated research program in which all the stations of the island participated. A coordinating committee was created and functioned actively. This committee included the dean of the college of agriculture, the director of the Federal station at Mayaguez, the director of the Insular station at Rio Piedras, and the commissioner of agriculture for the island. Excellent progress was made toward a joint cooperative research program.

Near the end of the year an allotment of \$113,000 from sugar-processing-tax funds was assigned to the Federal station at Mayaguez. Progress was made in organizing a program of research integrated with emergency activities and supplementing regular research activities in the interest of rehabilitating agriculture and improving standards of living.

## PUBLICATIONS

Publications of the Office designed to aid in carrying out the purposes of the Federal acts were continued as usual. Among the more important of these is, as it has been for many years, Experiment Station Record, a review of current literature and progress of research in agriculture and home economics and a medium for discussion of various timely matters bearing on such research.

## EXPERIMENT STATION RECORD

Experiment Station Record, under the editorship of Howard Lawton Knight and with a staff including practically all the specialists in the Office, continued its policy of monthly issues averaging 150 pages each. Volumes 71 and 72 were completed during the year, containing 3,302 and 3,486 abstracts, respectively, and in addition the customary editorials, news notes, and indexes. Special attention was devoted to insuring the completeness of the review of the experimental work carried on by the State experiment stations and reported in scientific journals and other nonstation publications. As usual, much assistance was given through correspondence and otherwise to institutions and individuals seeking to supplement the abstracts by more detailed information. Many additions were made to the mailing list of agricultural schools, substations, and other comparatively isolated workers, and of agencies immediately connected with the national recovery program, and it was evident that the service rendered to such groups is especially needed and welcome.

Cooperation with Biological Abstracts in the exchange of abstracts and in similar ways was maintained through F. V. Rand throughout the year, and considerable duplication of effort was thereby avoided.

## OTHER PUBLICATIONS SUPPLYING BASIC INFORMATION

In addition to Experiment Station Record, the Office continued to collect and publish complete and up-to-date information regarding personnel, organization, facilities for research, progress and results of work, publications, and finances of the experiment stations.

A complete list of these publications of the Office during the year follows:

Report of the Chief of the Office of Experiment Stations, 1934, by James T. Jardine.

Miscellaneous Publication 202, Federal Legislation, Rulings, and Regulations Affecting the State Agricultural Experiment Stations.

Miscellaneous Publication 214, Workers in Subjects Pertaining to Agriculture in State Agricultural Colleges and Experiment Stations, 1934-35, by M. A. Agnew.

Hawaii Station Bulletin 72, Napier Grass (*Pennisetum purpureum*): A Pasture and Green Fodder Crop for Hawaii, by C. P. Wilsie and M. Takahashi; and Report of the Hawaii Agricultural Experiment Station, 1934.

Puerto Rico Station Bulletin 36, Parasites and Parasitic Diseases of Cattle in Puerto Rico, by H. L. Van Volkenberg; and Report of the Puerto Rico Agricultural Experiment Station, 1934.

Journal of Agricultural Research papers: Maize Crossing Values in Second-generation Lines, by R. L. Davis, contributed by the Puerto Rico Station; The Nutritive Value of Green Immature Soybeans, by Carey D. Miller and Ruth C. Robbins, and Natural Crossing in the Pigeonpea, by C. P. Wilsie and Makoto Takahashi, contributed by the Hawaii Station.

## MANUSCRIPTS PREPARED FOR PUBLICATION

Publications in press or in course of preparation for printing by the Department at the close of the year included several numbers of Experiment Station Record; Report on the Agricultural Experiment Stations, 1934 (in press); Hawaii Station Bulletin 55 (reprint), Banana Culture in Hawaii, by W. T. Pope (in press); Hawaii Station Bulletin 74, The Edible Passion Fruit in Hawaii, by W. T. Pope (in press); Puerto Rico Station Bulletin 37, Parasites and Parasitic Diseases of Horses in Puerto Rico, by H. L. Van Volkenberg (in press); Puerto Rico Station Bulletin 38, Parasites and Parasitic Diseases of Swine in Puerto Rico, by H. L. Van Volkenberg (submitted for printing); and Journal of Agricultural Research articles, contributed by the Hawaii Station, on A Chemical Investigation of the Fermentations Occurring in the Process of Poi Manufacture, by Leonora Neuffer Bilger and Hong Yip Young (in press);



and Results of Feeding Sprouted Oats to Correct Sterility in Cattle and Swine, by L. A. Henke (in press).

Manuscripts of three bulletins of the Hawaii Station, to be published in Hawaii, were edited, as follows: Coffee Cultural Practices in the Kona District of Hawaii, by J. C. Ripperton and Y. B. Goto; Hawaiian Fruits: Their Composition, Nutritive Value, and Use, by Ruth C. Robbins, Katherine Bazone, and Carey D. Miller; and Location, Species, and Season as Factors in the Chemical Composition of Pasture Grasses, by D. W. Edwards and R. A. Goff. A manuscript for a bulletin, A Farm Management Study of Small Farms in Three Areas in Puerto Rico, was reviewed by the Office, and approved for printing by the Agricultural Experiment Station of the University of Puerto Rico, Rio Piedras.

The preceding summary shows that the Office printed or prepared for publication during the year 37 documents aggregating approximately 3,100 pages.

### LIBRARY AND BIBLIOGRAPHICAL SERVICE

The library of the Office, in charge of Cora L. Feldkamp, cooperating with the Department Library and the Extension Service, maintained as in previous years files of station, extension, Department, and other publications. These were circulated for the information of the Office staff, and for review in Experiment Station Record, and were made available for consultation by the Department as a whole, and, so far as facilities would permit, by State institutions and others.

The main duty of the Office library is examination of books and periodicals for selection of such as appear to contain matter requiring review in Experiment Station Record. The library circulated to the Record staff for this purpose during the year 1,646 books and 28,041 periodicals, as compared with 1,558 books and 27,472 periodicals the previous year. These were selected from approximately 11,000 books and 85,000 separate numbers of current periodicals available for examination by the library staff, including 1,086 station and 1,500 Department of Agriculture publications.

The seventh supplement to Department Bulletin 1199, giving an indexed list of station bulletins for the calendar years 1933 and 1934, was prepared by C. E. Pennington. Other bibliographical work included a continuation by H. V. Barnes of the index of articles contributed by the stations to outside journals. This index shows that 1,778 such articles were contributed by the stations to 69 journals during the year. In addition 30 stations contributed or collaborated in 69 articles published in the Journal of Agricultural Research. The library continued to prepare monthly lists of experiment station publications which were mimeographed and sent to librarians and others having special need for such lists. It was also called upon by the emergency agencies for considerable reference work in connection with the State agricultural experiment station and State extension publications.

By arrangement with the Department Library a list of articles published by the stations in outside journals was again included each month in Agricultural Library Notes.

### SPECIAL SERVICES

Calls for special services, always an important feature of the work of the Office, claimed a considerably increased amount of time and attention during the year. These calls included such matters as conferences with representatives of the different bureaus of the Department and of other departments, and of the experiment stations and other State agencies; service on various committees within and without the Department; preparation of special reports, papers, and compilations of information relating to the organization and work of the Office and the experiment stations; and national, regional, and local problems of relief and readjustment.

An important development of the year was the holding of four regional conferences dealing with cooperation on a regional basis and participated in by State experiment station and extension directors, the Assistant Secretary of Agriculture, the Assistant Administrator and Director of the Division of Program Planning of the Agricultural Adjustment Administration, the Director of Extension, and the Chief of the Office. These conferences were for the purpose of gaining "a better picture of the local and regional problems to which future agricultural policies should be adapted, the needs for research, and the possibilities of harmonizing adjustment programs more nearly with the principles of

conservation and proper land utilization", and were held in Ames, Iowa, March 4 and 5; Salt Lake City, Utah, March 7 and 8; Birmingham, Ala., March 11 and 12; and New York City, March 15 and 16, 1935.

Following these conferences a departmental committee on regional economic research and agricultural planning was set up by the Secretary of Agriculture on March 22, 1935, in order to organize and direct the programs for research there outlined and to establish cooperative relationships with the States. The Chief of the Office was designated as a member of this committee.

The Office was also represented by the Chief on a number of other committees of the Department for consideration of activities having a relationship to the work of the State stations. These committees included a permanent coordinating committee of three, the purpose of which is to work out the details of cooperation between the Soil Conservation Service, research bureaus of the Department, and State research agencies; the committee on basic scientific research; the cotton research committee; the committee on cooperation with the Tennessee Valley Authority; the committee on departmental manuscripts; the interbureau committee on plant and animal improvement; and the committee on pastures and forage crops.

The Chief of the Office continued to serve on two standing committees of the Association of Land-Grant Colleges and Universities—the committee on experiment station organization and policy, and the joint committee on projects and correlation of research. Assistance was given both these committees in the preparation of their reports.

#### DISTRIBUTION OF STATION PUBLICATIONS

A revision of the multigraphed list of agricultural research institutions and library centers in foreign countries, prepared by Howard Lawton Knight, editor of Experiment Station Record, largely on the basis of additional information which had become available, was distributed during the year. About 400 of the institutions deemed outstanding as to research or library facilities were classified as primary research centers, while about 1,000 additional institutions were listed, many of much importance in specialized lines. Assistance was also rendered the stations by conferences, correspondence, and in other ways, looking toward an increased effectiveness of their foreign distribution.

#### RESEARCH IN PLANT PATHOLOGY

On July 1, 1934, H. P. Barss, specialist in plant physiology and pathology, entered upon a 3-year appointment to the division of biology and agriculture of the National Research Council as the representative of the American Phytopathological Society and the Society of American Bacteriologists. He was subsequently elected secretary of the American Phytopathological Society for 3 years beginning January 1, 1935, and on May 7 was appointed by the Secretary of Agriculture as a member of the Departmental Committee on the Effect of Soil on the Biological Value of Dietary and Medicinal Plants.

#### RESEARCH IN ANIMAL HUSBANDRY

George Haines, specialist in animal husbandry of the Office, took part in a conference in August 1934 of station and Department specialists engaged in cooperative meat investigations and served as a member of several committees of the conference, especially those on laboratory methods, grading meats, and pork projects. H. W. Marston, specialist in animal husbandry and dairying, continued to serve as an unofficial member of the interbureau pasture committee of the Department and as a member of the interbureau hay committee. He also took part in the annual meeting of the American Society of Animal Production at Chicago in November 1934.

#### HOME ECONOMICS RESEARCH

The specialist of the Office in home economics research, Sybil L. Smith, continued to serve on various committees of the American Home Economics Association. She took part in committee work and conferences relating to home economics research at the annual meeting of the association and was in charge of a meeting of the research department devoted to the topic, Planning Research Projects in Various Fields of Home Economics. She was again chairman of the committee on research of the home economics section



of the Association of Land-Grant Colleges and Universities, presenting a report thereon at the Washington meeting, and was a member of the subcommittee for home economics of the standing committee of the association on experiment station organization and policy. She prepared a list of home economics research projects and reports of the land-grant institutions for the year ended June 30, 1934, which was distributed by the Office in mimeograph form. Miss Smith also presented a paper at the annual meeting of the Vegetable Growers of America at Toronto, entitled "Vegetables in the Diet.—I, Yesterday. II, Today. III, Tomorrow", which was subsequently published in the *Journal of Home Economics* (vol. 27 (1935), pp. 73-77, 146-151, 218-222).

#### RESEARCH IN AGRONOMY

H. M. Steece, agronomist of the Office, began during the year a critical analysis and summary of the currently active experiment station agronomic projects in field crops, soils, and fertilizers, and other major features of coordination with similar work active in the Department of Agriculture. He continued to serve on the committee on standardization of field experiments of the American Society of Agronomy, and on December 10, 1934, was appointed chairman of this committee.

#### RESEARCH IN AGRICULTURAL ENGINEERING

As in previous years, research in agricultural engineering received special assistance by service of R. W. Trullinger, specialist in agricultural engineering of the Office, on various committees of the American Society of Agricultural Engineers, and in other ways. He continued as a member of the research committee of the society, which dealt with the organization and coordination of research and the planning of research programs in agricultural engineering with particular reference to the requirements of the emergency and other research efforts toward agricultural adjustment. In that connection he presented a paper at a regional convention of the society entitled "The Opportunities of the Agricultural Engineer for Aiding Recovery." In addition he supervised the preparation of the *Monthly Digest of Agricultural Engineering Progress*. He was chairman of a joint committee on rural sanitation sponsored by the American Society of Agricultural Engineers, the conference of State sanitary engineers, and the public health engineering section of the American Public Health Association which organized plans for research on the sanitary features of dairy-production structures and other animal-shelter structures for coordination with other research at the experiment stations and elsewhere and aimed at preventing the spread and transmission to human beings of diseases of both animal and human origin. Mr. Trullinger continued as chairman of an international committee on materials for agricultural machines which organized research aimed at greater economy and durability in the use of ferrous-metal parts for machines, and standardization in their design. He also was one of the official representatives of the society on the American Engineering Council and served in an advisory capacity to its subcommittees on rural electrification and land uses and as its representative on the Federal Board of Surveys and Maps. He also served as the research member of the radio committee of the Department which supervised the Land-Grant College Radio Hour presented by the Association of Land-Grant Colleges and Universities in cooperation with the Department.

#### RESEARCH AMONG THE NAVAJO INDIANS

In response to a request of the Bureau of Indian Affairs of the Interior Department, B. Youngblood was engaged from July 6 to October 8 in a study of economic and social conditions among the Navajo Indians, particularly the operation of trading posts and the relation of the Indians thereto. Subsequently he analyzed and interpreted these data and submitted a tentative report to the Commissioner of Indian Affairs. His recommendations included the establishment of an Indian sheep range breeding laboratory or experiment station for the study of sheep breeding and related problems and the development of a breed of sheep adapted to the Navajo country and to the economic and social requirements of the Navajo Indian. Such a laboratory has been authorized under a Congressional appropriation of \$75,000. It is expected that it will be located at Fort Wingate, N. Mex., and that it will be conducted in cooperation with the Bureau of Animal Industry of the Department and the New Mexico Agricultural Experiment Station, with advice on sheep-breeding problems by sheep specialists of other stations in the region.

## HORTICULTURAL RESEARCH

J. W. Wellington, horticulturist of the Office, participated in a conference of pomologists held September 21, 1934, at the New York State Agricultural Experiment Station, with a view to the scrutiny of existing projects and to coordinating the attack on regional problems. A list of station pomological projects prepared in the Office and classified by subject matter was used as a basis of the discussion.

## MICROSCOPIC TECHNIC AND APPARATUS

Five papers presented by H. C. Waterman, of the Office staff, were accepted for publication in *Stain Technology*. These included Notes on Belling's Methods for Critical Microscopy, III to VI (*Stain Technol.*, vol. 10 (1935), pp. 97-100), and A Microscopic Lamp Especially Designed for the Belling Method (*Stain Technol.*, vol. 10 (1935), pp. 113-126).

## RESTORATION OF OFFICE QUARTERS

On July 16, 1934, the administrative headquarters and other units, which had been located for nearly a year in temporary quarters about one-half mile distant, returned to essentially the space previously occupied in the South Building. Advantage was taken of the opportunity for space reassignments. The reconcentration of all Office activities on a single floor and in close proximity to the Library and other units of the Department has proved of much convenience and improved efficiency.

## PASSAGE OF THE BANKHEAD-JONES ACT

Substantially increased Federal aid for basic agricultural research, agricultural extension, and land-grant college instruction was authorized in the Bankhead-Jones Act, which was signed by President Roosevelt on June 29, 1935. The act became effective immediately, and the appropriations authorized for the fiscal year ending June 30, 1936, were provided in the Second Deficiency Appropriation Act approved August 12, 1935. These funds included \$980,000 for land-grant college instruction, \$8,000,000 for agricultural extension, and \$1,000,000 for agricultural research. Further increases are authorized for subsequent years till the beginning of the fiscal year 1940, when the annual maximum for all purposes is reached at \$18,500,000.

The increased appropriations vary as to amounts with the different classes of expenditure. For resident instruction, the land-grant colleges may receive for the fiscal year 1937 not to exceed \$1,480,000; for 1938, \$1,980,000; and for 1939 and each year thereafter, \$2,480,000. For extension work the allotments increase by \$1,000,000 per annum to a continuing maximum of \$12,000,000, and for research, by \$1,000,000 per annum to a continuing maximum of \$5,000,000. The act expressly provides that all its grants are to be in addition to sums authorized by previous legislation.

As regards agricultural research, the act contemplates enlarged activities by both the State experiment stations and the Federal Department of Agriculture. Sixty percent of the amounts provided are to be available to the States, Alaska, Hawaii, and Puerto Rico. The basis of allotment is to be their respective rural populations, but the appropriations are also conditioned upon the making available in each case an equal amount of funds from non-Federal sources for purposes of research and for the establishment and maintenance of necessary facilities for the prosecution of such research. Sums withheld because of this provision may be reallocated by the Secretary of Agriculture to other States and Territories up to 20 percent of their original quota.

The administration of this portion of the act is entrusted to the Secretary of Agriculture, and this Office has been designated to represent the Department in all matters relating to the administrative details in the expenditure of the funds allotted and to aid in the promotion of research activities under this act and of coordination with other agricultural research in the same general way as it has heretofore in relation to the Hatch, Adams, and Purnell Acts. Regulations and policies for the administration of this important legislation were being formulated at the close of the year.



Extension Service

No report of director  
as yet published.





## REPORT OF THE DIRECTOR OF FINANCE, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF BUDGET AND FINANCE,  
*Washington, D. C., October 7, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith the report of the work of the Office of Budget and Finance for the fiscal year ended June 30, 1935.

Sincerely,

W. A. JUMP, *Director.*

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### INTRODUCTION

To facilitate the handling of the increased volume of work incident to the great expansion of the financial operations of the Department within recent years, the Office of Budget and Finance, formerly a part of the Office of Personnel and Business Administration, was established on June 1, 1934 (Secretary of Agriculture Memorandum 646), as a separate branch of the Office of the Secretary. This Office is charged with the preparation of the Department's budget and exercises general supervision and control of its fiscal, accounting, purchasing, and related activities. It conducts the business of the Department with the Bureau of the Budget, the Treasury Department, the Appropriations Committees of the House and Senate, and other agencies of the Government concerned with fiscal and related matters.

The work of the Office, including detailed information regarding the Department's budget for the fiscal years 1935 and 1936, is discussed under division heads in the accompanying report.

### DIVISION OF ESTIMATES AND REPORTS

Under the direction of the Budget officer, the Division of Estimates and Reports cooperates with the bureaus and offices of the Department in the preparation of the annual estimates of appropriations submitted to Congress for the operation of the Department of Agriculture, and compiles the detailed schedules and supporting statements required in connection therewith by the Bureau of the Budget, the Appropriations Committees of the House and Senate, and the Department's administrative officers.

It also maintains a legislative information unit, primarily to serve the various branches of the office of the Secretary, which prepares a daily digest of the proceedings of Congress, with particular reference to matters pertaining to agriculture and related subjects or having general application to the Department, and maintains suitable files of congressional bills and reports, with the necessary indexes.

In addition, the Division prepares statements and reports relating to the finances and work of the Department, analyzing and classifying its appropriations and expenditures, for the information of Members of Congress, other Government departments, State institutions, business organizations, and private individuals. It also reviews questionnaires that are to be sent out by bureaus to various groups, with a view to providing better coordination in handling such requests in the Department as a whole and reducing to a minimum the demands on outside agencies for services of this character.

## THE DEPARTMENT BUDGET

## REGULAR FUNDS

In the fiscal year 1935 the obligations incurred under regular appropriations administered by the Department of Agriculture totaled \$190,085,405, including \$129,045,867 for roads. These obligations are summarized in tables 1 and 3.

## EMERGENCY FUNDS

In addition to the regular Budget, emergency funds amounting to \$1,526,842,661, including balances brought forward from prior years, were available for obligation during the fiscal year 1935, of which \$1,317,230,604 was actually obligated in that year. For the fiscal year 1936 there was available for obligation up to August 31, 1935, a total of \$903,473,209 from various emergency funds, including allocations under the Emergency Relief Appropriation Act of 1935. For details of obligations for 1935 and amounts available for obligation in 1936 from these funds, see table 5.

Table 1 summarizes the regular and emergency funds available for the fiscal years 1935 and 1936, with the obligations incurred during 1935 and the amounts available for obligation in 1936.

TABLE 1.—*Summary of Department of Agriculture funds for the fiscal years 1935 and 1936 (as of Aug. 31, 1935)*

[For more detailed statements see tables 3, 4, and 5]

Item	Available for obligation, 1935	Obligations, 1935	Available for obligation, 1936
<b>Regular appropriations:</b>			
All objects except road construction.....	\$65,802,563	\$61,039,538	\$80,539,723
Road funds.....	9,530,000	129,045,867	58,141,856
Total, regular appropriations.....	75,332,563	190,085,405	138,681,579
<b>Emergency appropriations and allocations (including balances brought forward from prior years):</b>			
Road funds (all emergency sources).....	413,684,741	413,634,739	50,002
Agricultural Adjustment Administration.....	1,014,645,969	856,169,593	717,722,139
National Industrial Recovery Act (exclusive of road and A. A. A. funds).....	28,545,415	27,575,123	4,965,982
Emergency Appropriation Act, 1935 (exclusive of road and A. A. A. funds).....	23,748,536	18,929,936	1,912,135
Emergency Relief Appropriation Act of 1935 (exclusive of road funds) <sup>2</sup> .....	43,650,000	793,147	<sup>3</sup> 74,076,276
Act of Aug. 24, 1935:			
Encouraging exportation of agricultural commodities, etc.....			<sup>4</sup> 92,111,741
Elimination of diseased beef and dairy cattle.....			10,000,000
Puerto Rico and Hawaii trust funds (Agricultural Adjustment Act, as amended by Jones-Costigan Act).....	2,568,000	128,066	2,634,934
Total, emergency appropriations.....	1,526,842,661	1,317,230,604	903,473,209
Grand total.....	1,602,175,224	1,507,316,009	1,042,154,788

<sup>1</sup> Includes 1936 authorizations obligated in 1935 as provided by law.

<sup>2</sup> Allocations to Aug. 31, 1935.

<sup>3</sup> Includes \$42,856,853 balance from 1935 allocations and \$31,219,423 additional allocations in 1936 (to Aug. 31, 1935).

<sup>4</sup> An amount equal to 30 percent of gross customs receipts.



Table 2 shows the source of the regular appropriations of the Department for the fiscal years 1935 and 1936, with necessary itemization under deficiency and special appropriation heads.

TABLE 2.—*Source of regular appropriations of Department of Agriculture, fiscal years 1935 and 1936 (as of Aug. 31, 1935)*

Source	Appropriation, 1935	Appropriation, 1936
Agricultural Appropriation Act.....	\$60,232,007	\$121,157,983
Acts of Mar. 28, 1934, and Feb. 13, 1935 (for salary adjustments).....	1,206,900	-----
Deficiency Appropriation Act, 1934:		
Forest-fire cooperation.....	225,000	-----
Administration of Federal Hunting Stamp Act (advances from migratory-bird conservation fund).....	150,000	-----
Roads within grounds at Monticello, Va.....	30,000	-----
Citrus laboratory, Weslaco, Tex.....	7,500	-----
Collection and analysis of economic data on agricultural products for use in carrying out Reciprocal Trade Agreement Act of June 12, 1934.....	47,670	-----
First Deficiency Appropriation Act, 1935:		
Fighting forest fires.....	2,348,000	-----
Control of predatory animals and injurious rodents (reimbursing funds diverted to purchase of winter elk feed).....	15,000	-----
Second Deficiency Act, 1935:		
West Indian fruit fly and black fly control.....	-----	36,000
Maintenance of mammal and bird reservations (feed for elk).....	-----	25,000
Enforcement of Cotton Futures and Cotton Standards Act (office in Texas).....	-----	10,000
To carry into effect the Bankhead-Jones Research and Extension Act of June 29, 1935:		
Research (special research by Department of Agriculture and payments to States, Hawaii, Alaska, and Puerto Rico).....	-----	1,000,000
Extension: Payments to States and Hawaii.....	-----	8,000,000
Permanent annual and indefinite appropriations:		
Cooperative agricultural extension work (Smith-Lever Act).....	4,676,096	4,686,096
Meat inspection.....	3,000,000	(1)
Refunds to depositors, national-forest fund.....	60,000	(2)
National Forest Reservation Commission.....	6,400	(1)
Payments to States and Territories, national-forest fund.....	660,000	660,000
Payments to school funds, Arizona and New Mexico (national-forest fund).....	28,500	28,500
Roads and trails for States, national-forest fund.....	475,000	328,000
Cooperative work, Forest Service (contributed funds).....	2,000,000	2,000,000
Migratory-bird conservation fund.....	130,000	750,000
Expenses, Cotton Standards Act.....	34,490	(1)
Classification of cotton, revolving fund.....	130,000	(1)
Total, permanent and indefinite.....	11,070,486	8,452,596
Total, regular funds.....	75,332,563	138,681,579

<sup>1</sup> Abolished as a permanent appropriation by the Permanent Appropriation Repeal Act of June 26, 1934, and carried under the annual Agricultural Appropriation Act.

<sup>2</sup> Abolished by Permanent Appropriation Repeal Act; requirements included under Refund of moneys erroneously received and covered, Treasury Department.

Table 3 summarizes the regular appropriations of the Department under group and bureau classifications, and table 4 gives this information in detail under subappropriation heads.

TABLE 3.—*Statement of regular Department of Agriculture funds, classified by group and bureau units, for fiscal years 1935 and 1936 (as of Aug. 31, 1935)*

Activity	Appropriation, 1935 <sup>1</sup>	Obligations, 1935	Appropriation, 1936 <sup>2</sup>
<b>ORDINARY ACTIVITIES:</b>			
Office of the Secretary.....	\$588,511	\$563,285	\$582,959
Office of the Solicitor.....	173,858	172,510	181,201
Office of Information.....	1,016,538	1,015,095	1,163,282
Library.....	92,187	91,687	99,812
Office of Experiment Stations.....	214,791	212,840	625,546
Extension Service.....	860,903	840,185	902,754

<sup>1</sup> All regular funds, including \$1,145,854 additional provided by acts of Mar. 28, 1934, and Feb. 13, 1935 for salary restoration and \$61,046 to cover 40-hour week.

<sup>2</sup> Includes all regular funds made available up to Aug. 31, 1935.

TABLE 3.—Statement of regular Department of Agriculture funds, classified by group and bureau units, for fiscal years 1935 and 1936 (as of Aug. 31, 1935—Continued)

Activity	Appropriation, 1935	Obligations, 1935	Appropriation, 1936
<b>ORDINARY ACTIVITIES—Continued.</b>			
Weather Bureau.....	\$3, 196, 763	\$3, 192, 546	\$3, 439, 204
Bureau of Animal Industry.....	11, 323, 519	10, 061, 894	11, 314, 259
Bureau of Dairy Industry.....	599, 660	594, 404	671, 594
Bureau of Plant Industry.....	3, 871, 023	3, 849, 050	4, 483, 206
Forest Service.....	7, 402, 677	7, 473, 989	10, 057, 614
Bureau of Chemistry and Soils.....	1, 110, 617	1, 098, 963	1, 335, 772
Bureau of Entomology and Plant Quarantine.....	3, 402, 758	3, 430, 924	4, 836, 821
Bureau of Biological Survey.....	1, 751, 616	1, 295, 400	2, 196, 492
Bureau of Agricultural Engineering.....	370, 743	365, 259	423, 269
Bureau of Agricultural Economics.....	5, 401, 628	5, 331, 028	5, 734, 801
Bureau of Home Economics.....	190, 272	189, 166	193, 485
Grain Futures Administration.....	190, 165	184, 816	196, 500
Food and Drug Administration.....	1, 644, 355	1, 642, 528	1, 968, 637
Beltsville Research Center.....			75, 000
Total, ordinary activities.....	43, 402, 584	41, 605, 569	50, 482, 208
<b>Special items:</b>			
Soil Conservation Service <sup>3</sup> .....	176, 175	176, 032	665, 408
Forest-fire deficiency (Forest Service).....	2, 348, 000	2, 315, 060	-----
Grasshopper control (Bureau of Entomology and Plant Quarantine).....	2, 354, 893	171, 372	-----
Chinch-bug control (Bureau of Entomology and Plant Quarantine).....		54, 026	2, 500, 000
Screwworm control (Bureau of Entomology and Plant Quarantine).....		60, 000	480, 000
Total, special items.....	4, 879, 068	2, 776, 490	3, 645, 408
Forestry receipts and special funds.....	2, 754, 900	1, 924, 003	3, 024, 000
Total, all foregoing items.....	51, 036, 552	46, 306, 062	57, 151, 616
<b>Payments to States (exclusive of road funds and forest-receipt funds):</b>			
State agricultural experiment stations for research (Office of Experiment Station).....	4, 388, 000	4, 388, 000	4, 995, 000
State colleges of agriculture for extension work (Extension Service).....	8, 748, 096	8, 723, 258	16, 758, 096
Forest-fire cooperation (Forest Service).....	1, 573, 619	1, 566, 605	1, 578, 632
Cooperative distribution of forest planting stock (Forest Service).....	56, 296	55, 613	56, 379
Total, payments to States, as above.....	14, 766, 011	14, 733, 476	23, 388, 107
Total, regular funds, exclusive of road funds.....	65, 802, 563	61, 039, 538	80, 539, 723
<b>Road funds (regular):</b>			
Federal-aid highway system.....	8, 000, 000	125, 000, 000	48, 559, 256
Forest roads and trails.....	1, 500, 000	1, 500, 000	7, 082, 600
Public-lands highways.....		2, 500, 000	2, 500, 000
Roads at Monticello, Va.....	30, 000	30, 000	
Mount Vernon Memorial Highway.....		15, 867	
Total, road funds (regular).....	9, 530, 000	129, 045, 867	58, 141, 856
Grand total (all regular funds).....	75, 332, 563	190, 085, 405	138, 681, 579

<sup>3</sup> This provides for the continuation of research work heretofore conducted by the Department under regular funds. The soil-conservation control program is financed from emergency funds, as shown in table 5.

<sup>4</sup> Includes 1936 authorizations obligated in 1935 as provided by law.



TABLE 4.—*Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)*

Bureau and item	Appropriation, 1935 <sup>1</sup>	Obligations, 1935 <sup>2</sup>	Appropriation, 1936
<b>ORDINARY ACTIVITIES:</b>			
Office of the Secretary:			
Salaries.....	\$413,263	<sup>3</sup> \$412,755	\$406,311
Miscellaneous expenses.....	112,248	<sup>4</sup> 88,734	113,648
Rent of buildings.....	63,060	61,796	63,000
Total.....	588,511	563,285	582,959
Office of the Solicitor: Salaries and expenses.....	<sup>5</sup> 173,858	172,510	<sup>6</sup> 181,201
Office of Information:			
Salaries and expenses.....	345,026	343,583	363,282
Printing and binding.....	<sup>7</sup> 671,512	671,512	800,000
Total.....	1,016,538	1,015,095	1,163,282
Library: Salaries and expenses.....	92,187	91,687	99,812
Office of Experiment Stations:			
General administration.....	145,855	144,425	156,235
Hawaii Experiment Station.....	32,977	32,881	32,066
Puerto Rico Experiment Station.....	35,959	35,534	37,245
Special research fund (act of June 29, 1935).....			<sup>8</sup> 400,000
Total.....	214,791	212,840	625,546
Extension Service:			
General administrative expenses.....	13,202	12,991	13,668
Farmers' cooperative demonstrations.....	722,960	<sup>9</sup> 708,319	747,248
Agricultural exhibits at fairs.....	69,960	69,502	85,000
Cooperative farm forestry.....	54,781	49,373	56,838
Total.....	860,903	840,185	902,754
Weather Bureau:			
General administrative expenses.....	120,287	119,610	124,840
General weather service and research.....	1,903,064	1,902,612	2,040,968
Meteorological station, western Montana.....			10,000
Horticultural protection.....	33,488	32,933	49,467
Aerology.....	1,139,924	1,137,391	1,213,929
Total.....	3,196,763	3,192,546	3,439,204
Bureau of Animal Industry:			
General administrative expenses.....	172,635	169,362	178,220
Inspection and quarantine.....	658,695	641,709	681,174
Tuberculosis eradication:			
Operating expenses.....	1,099,739	1,061,140	1,131,616
Indemnities.....	<sup>10</sup> 1,938,835	932,211	1,500,000

<sup>1</sup> Includes additional appropriations of \$1,145,854 provided by acts of Mar. 28, 1934, and Feb. 13, 1935, for partial salary restoration (to 95 percent for July 1934–March 1935 and to 100 percent for April–June 1935) and \$61,046 by act of March, 28, 1934, to cover 40-hour week; also involves transfer of \$1,061,165 from Salaries and expenses, B. A. I., to other appropriations to apply on such salary adjustments.

<sup>2</sup> In a few instances the obligation figures in this column exceed the 1935 total appropriations shown for the items. This is due to the fact that the appropriations as listed herein have in such cases been augmented through the transfer of funds from other items, through availability of unexpended balances from appropriations for prior years, or through the addition of amounts made immediately available in the 1936 appropriation act. In the case of some of the road funds, the "obligations" differ materially from the "appropriations" for the reason that the road money is usually obligated immediately on the passage of the appropriation act, and the amounts obligated are charged to the year in which the obligations or allocations are actually made.

<sup>3</sup> Includes \$34,038 covering transfer of personnel to Division of Disbursements and \$6,480 to Procurement Division, Treasury Department.

<sup>4</sup> Includes \$1,600 transferred to Division of Disbursements, Treasury Department.

<sup>5</sup> Transferred from Office of the Secretary (\$171,058 from "Salaries" and \$2,800 from "Miscellaneous expenses").

<sup>6</sup> Transferred from Office of the Secretary (\$178,401 from "Salaries" and \$2,800 from "Miscellaneous expenses").

<sup>7</sup> Includes \$61,046 to cover 40-hour week provision, authorized by sec. 23 of act of Mar. 28, 1934.

<sup>8</sup> Part of \$1,000,000 provided by Second Deficiency Act, 1935.

<sup>9</sup> Includes \$244,335 for salaries and expenses of field extension agents, supplementing direct Federal-aid payments to States.

<sup>10</sup> Exclusive of \$1,061,165 transferred to other department appropriations, to apply on salary restorations; but includes \$438,835 held as unapportioned reserve. (Actual total provided for tuberculosis indemnities in 1935 appropriation act was \$3,000,000.)

TABLE 4.—Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)—Continued

Bureau and item	Appropriation, 1935	Obligations, 1935	Appropriation, 1936
<b>ORDINARY ACTIVITIES—Continued.</b>			
<b>Bureau of Animal Industry—Continued.</b>			
Eradicating cattle ticks.....	\$595,097	\$588,522	\$613,940
Animal-husbandry investigations.....	<sup>11</sup> 647,842	643,561	<sup>12</sup> 758,503
Diseases of animals.....	355,569	351,132	381,755
Eradicating hog cholera.....	361,250	347,023	373,424
Eradicating dourine.....	8,331	4,981	8,613
Packers and Stockyards Act.....	324,273	316,703	331,879
Meat inspection.....	5,161,253	5,005,550	5,355,135
Total.....	11,323,519	10,061,894	11,314,259
<b>Bureau of Dairy Industry:</b>			
General administrative expenses.....	60,235	60,202	66,075
Dairy investigations.....	<sup>13</sup> 539,425	534,202	<sup>14</sup> 605,519
Total.....	599,660	594,404	671,594
<b>Bureau of Plant Industry:</b>			
General administrative expenses.....	182,719	182,431	189,242
Arlington Farm.....	47,221	46,050	49,414
Botany.....	35,929	35,795	76,635
Cereal crops and diseases.....	<sup>15</sup> 445,611	444,355	<sup>16</sup> 505,721
Cotton and other fiber crops and diseases.....	<sup>17</sup> 199,735	198,690	406,435
Drug and related plants.....	35,773	34,494	47,139
Dry-land agriculture.....	208,836	207,889	215,578
Experimental greenhouse maintenance.....	75,970	75,486	78,632
Forage crops and diseases.....	<sup>18</sup> 185,236	184,395	<sup>19</sup> 290,193
Forest pathology.....	249,390	244,391	252,092
Fruit and vegetable crops and diseases.....	<sup>20</sup> 1,046,966	1,043,519	<sup>21</sup> 1,115,454
Genetics and biophysics.....	30,577	30,537	31,675
Mycology and disease survey.....	41,969	41,120	42,818
National Arboretum.....	4,314	4,284	19,307
Nematology.....	42,515	40,894	43,961
Plant exploration and introduction.....	<sup>22</sup> 220,754	214,309	204,483
Plant nutrition.....	15,654	15,557	16,024
Plant-reserve stations.....			( <sup>23</sup> )
Rubber and other tropical plants.....	<sup>24</sup> 45,570	45,488	46,749
Seed investigations.....	65,223	65,061	67,293
Soil-fertility investigations.....	<sup>25</sup> 168,328	166,511	172,157
Soil-microbiology investigations.....	<sup>25</sup> 38,971	38,202	39,854
Sugar-plant investigations.....	<sup>26</sup> 302,945	298,498	312,079
Tobacco investigations.....	73,647	73,163	137,744
Western irrigation agriculture.....	<sup>27</sup> 107,170	117,931	122,527
Total.....	3,871,023	3,849,050	4,483,206
<b>Forest Service:</b>			
General administrative expenses.....	<sup>28</sup> 286,477	294,593	358,300
Protection and administration of national forests.....	<sup>28</sup> 5,977,922	5,928,593	8,009,577
Fighting forest fires.....	100,000	100,000	100,000

<sup>11</sup> Includes \$25,177 transferred from "Livestock production, southern United States."<sup>12</sup> Includes \$25,840 transferred from "Livestock production, southern United States"; excludes \$25,000 transferred to "Dairy investigations" (Bureau of Dairy industry) for Red Danish dual-purpose cattle research.<sup>13</sup> Includes \$10,147 transferred from "Livestock production, southern United States."<sup>14</sup> Includes \$10,415 transferred from "Livestock production, southern United States", and \$25,000 transferred from "Animal husbandry investigations" (Bureau of Animal Industry) for Red Danish dual-purpose cattle research.<sup>15</sup> Includes \$3,707 transferred from "Forage crops and diseases" for grain-sorghum work.<sup>16</sup> Includes \$3,798 transferred from "Forage crops and diseases" for grain-sorghum work.<sup>17</sup> Includes \$16,851 transferred from "Rubber, fiber, and other tropical plants" for fiber-plant work.<sup>18</sup> Includes \$3,554 transferred from "Livestock production, southern United States"; excludes \$3,707 transferred to "Cereal crops and diseases" for grain-sorghum work.<sup>19</sup> Includes \$3,645 transferred from "Livestock production, southern United States"; excludes \$3,798 transferred to "Cereal crops and diseases" for grain-sorghum work.<sup>20</sup> Includes \$20,000 transferred from "Plant exploration and introduction" for fruit-utilization work at Beltsville, Md., and \$8,180 from "Sugar-plant investigations" for curly top diseases of vegetables; excludes \$12,046 transferred to "Plant exploration and introduction" for bibliographical studies on insecticidal plants, and \$14,999 transferred to "Agricultural chemical investigations" (Bureau of Chemistry and Soils) for fruit- and vegetable-utilization work.



TABLE 4.—Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)—Continued

Bureau and item	Appropriation	Obligations, 1935	Appropriation, 1936
<b>ORDINARY ACTIVITIES—Continued.</b>			
Forest Service—Continued.			
Classification of lands.....	(20)		
Forest management.....	\$414, 199	\$412, 817	\$504, 494
Range investigations.....	84, 775	83, 687	154, 435
Forest products.....	488, 778	485, 933	508, 361
Forest survey.....	(30)		250, 000
Forest economics.....	50, 526	50, 521	73, 295
Acquisition of additional forest lands.....		31 117, 845	
Soil-erosion investigations (allotment) 32.....	(30)		99, 152
Total.....	7, 402, 677	7, 473, 989	10, 057, 614
Bureau of Chemistry and Soils:			
General administrative expenses.....	89, 523	87, 547	90, 241
Agricultural chemical investigations.....	33 345, 708	341, 370	34 440, 268
Color investigations.....	67, 324	67, 244	69, 757
Insecticide and fungicide investigations.....	(35)		
Plant-dust explosions.....	33, 627	32, 133	34, 881
Naval stores investigations.....	59, 871	59, 642	76, 741
Fertilizer investigations.....	261, 320	259, 449	269, 595
Soil chemical and physical investigations.....	50, 853	50, 360	68, 081
Soil survey.....	202, 391	201, 218	286, 208
Soil-microbiology investigations.....	(36)		
Soil-fertility investigations.....	(36)		
Total.....	1, 110, 617	1, 098, 963	1, 335, 772
Bureau of Entomology and Plant Quarantine:			
General administrative expenses.....	158, 449	158, 104	162, 288
Fruit insects.....	338, 739	336, 056	399, 531
Japanese beetle control.....	241, 950	238, 509	350, 000
Mexican fruit fly control.....	107, 157	106, 447	140, 460
Citrus canker eradication.....	13, 039	12, 872	13, 485
Phony peach eradication.....	48, 187	47, 585	49, 828
Date scale control.....	24, 073	23, 922	24, 856
Forest insects.....	154, 005	153, 785	37 159, 415
Gypsy and brown-tail moth control.....	(30)		400, 000
White pine blister rust control.....	(30)		250, 000
Dutch elm disease eradication.....	35 157, 020	180, 761	261, 156
Truck-crop and garden insects.....	319, 048	318, 585	361, 418
Cereal and forage insects.....	329, 741	327, 590	347, 229
European corn borer control.....	31, 991	31, 893	32, 939
Barberry eradication.....	(30)		200, 000
Cotton insects.....	143, 075	141, 894	147, 244

<sup>21</sup> Includes \$600 transferred from "Forest insects" (Bureau of Entomology and Plant Quarantine) for azalea flower-blight investigations, and excludes \$36,338 transferred to "Agricultural chemical investigations" (Bureau of Chemistry and Soils) for fruit- and vegetable-utilization work.

<sup>22</sup> Includes \$12,046 transferred from "Fruit and vegetable crops and diseases" for bibliographical studies on insecticidal plants; excludes \$20,000 transferred to same item (see note 20).

<sup>23</sup> The appropriation provided under this head for 1936 has been transferred to the Soil Conservation Service (which see).

<sup>24</sup> Excludes \$16,851 transferred to "Cotton and other fiber crops and diseases" for fiber-plant investigations.

<sup>25</sup> Transferred from Bureau of Chemistry and Soils.

<sup>26</sup> Excludes \$3,180 transferred to "Fruit and vegetable crops and diseases" for curly top diseases of vegetables.

<sup>27</sup> In addition, \$12,000 was reappropriated from 1933 unexpended balance.

<sup>28</sup> See note 29.

<sup>29</sup> \$10,355 transferred to "General administrative expenses" and \$20,555 to "Protection and administration of national forests" (total in 1935 appropriation act, \$30,910).

<sup>30</sup> Financed in 1935 under Public Works funds.

<sup>31</sup> Obligations under continuing prior-year appropriations.

<sup>32</sup> Item carried under "Miscellaneous", Agricultural Appropriation Act.

<sup>33</sup> Includes \$7,500 provided by Deficiency Appropriation Act, 1934, for Weslaco (Tex.) citrus laboratory and \$14,999 transferred from "Fruit and vegetable crops and diseases" (Bureau of Plant Industry) for fruit- and vegetable-utilization work.

<sup>34</sup> Includes \$36,338 transferred from "Fruit and vegetable crops and diseases" (Bureau of Plant Industry) for fruit- and vegetable-utilization work and \$20,000 from "Insecticide and fungicide investigations" (Bureau of Entomology and Plant Quarantine) for studies of toxic effects of insecticides on warm-blooded animals.

<sup>35</sup> Transferred to Bureau of Entomology and Plant Quarantine.

<sup>36</sup> Transferred to Bureau of Plant Industry.

<sup>37</sup> Excludes \$600 transferred to "Fruit and vegetable crops and diseases" (Bureau of Plant Industry) for azalea flower-blight work.

<sup>38</sup> Financed also in 1935 under emergency funds.

TABLE 4.—*Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)*—Continued

Bureau and item	Appropriation, 1935	Obligations, 1935	Appropriation, 1936
<b>ORDINARY ACTIVITIES—Continued.</b>			
<b>Bureau of Entomology and Plant Quarantine—Continued.</b>			
Pink bollworm control.....	\$268,734	\$267,680	\$276,089
Thurberia weevil control.....	2,724	2,632	2,883
Bee culture.....	48,370	47,278	60,000
Insects affecting man and animals.....	116,190	120,927	128,148
Insect-pest survey and identification.....	129,851	129,737	134,798
Control investigations.....	43,068	42,855	62,518
Insecticide and fungicide investigations.....	<sup>25</sup> 93,460	92,607	<sup>39</sup> 148,684
Transit inspection.....	28,069	27,712	29,059
Foreign-plant quarantines.....	<sup>40</sup> 588,578	604,333	625,955
Certification of exports.....	17,210	17,160	31,862
West Indian fruit fly and black fly control.....	( <sup>30</sup> )		30,000
<b>Total.....</b>	<b>3,402,758</b>	<b>3,430,924</b>	<b>4,836,821</b>
<b>Bureau of Biological Survey:</b>			
General administrative expenses.....	77,659	77,563	79,595
Maintenance of mammal and bird reservations.....	55,221	73,656	<sup>41</sup> 81,727
Food habits of birds and animals.....	56,349	79,093	60,640
Control of predatory animals and injurious rodents.....	457,993	418,269	600,000
Production of fur-bearing animals.....	54,691	54,592	56,112
Biological investigations.....	74,073	73,712	118,149
Protection of migratory birds.....	163,064	161,426	222,978
Enforcement of Alaska game law.....	69,946	69,553	96,596
Upper Mississippi River Refuge.....	35,519	37,595	36,625
Bear River Migratory Bird Refuge.....	16,153	16,128	16,559
Migratory bird conservation refugees.....	65,948	60,332	77,510
Advances to migratory-bird conservation fund.....	<sup>42</sup> 150,000	146,775	
Migratory-bird conservation fund.....	<sup>43</sup> 475,000	26,676	<sup>45</sup> 750,000
<b>Total.....</b>	<b>1,751,616</b>	<b>1,295,400</b>	<b>2,196,492</b>
<b>Bureau of Agricultural Engineering:</b>			
General administrative expenses.....	36,200	36,065	37,600
Agricultural engineering investigations.....	334,543	329,194	385,669
<b>Total.....</b>	<b>370,743</b>	<b>365,259</b>	<b>423,269</b>
<b>Bureau of Agricultural Economics:</b>			
General administrative expenses.....	242,750	242,715	236,306
Farm management and practice.....	332,000	328,234	344,080
Marketing and distributing farm products.....	<sup>44</sup> 664,374	652,323	743,654
Crop and livestock estimates.....	640,181	640,060	661,289
Foreign competition and demand.....	<sup>45</sup> 269,440	262,967	289,000
Market inspection of farm products.....	414,165	405,097	431,203
Market-news service.....	1,048,524	1,039,312	1,076,492
Cotton grade and staple statistics.....	218,059	218,050	224,517
Tobacco stocks and standards.....	16,642	16,635	17,187
Perishable Agricultural Commodities Act.....	127,181	123,280	131,466
Cotton Futures and Cotton Standards Acts.....	<sup>46</sup> 404,177	401,228	<sup>47</sup> 487,111
Grain Standards Act.....	684,672	673,597	708,941
Warehouse Act.....	283,690	275,985	316,665
Standard Container, Hamper, and Produce Agency Acts.....	29,035	26,092	30,238
Establishing wool standards.....	26,738	25,453	27,652
<b>Total.....</b>	<b>5,401,628</b>	<b>5,331,028</b>	<b>5,734,801</b>

<sup>25</sup> Transferred from Bureau of Chemistry and Soils.<sup>39</sup> Excludes \$20,000 transferred to "Agricultural chemistry investigations" (Bureau of Chemistry and Soils) for studies of toxic effects of insecticides on warm-blooded animals.<sup>40</sup> In addition, \$16,000 was reappropriated from 1933 unexpended balance.<sup>41</sup> Includes \$25,000 provided by Second Deficiency Act, 1935, for elk feed.<sup>42</sup> Provided by Deficiency Appropriation Act, 1934.<sup>43</sup> Receipts from hunting stamps authorized by act of Mar. 16, 1934 (Public, 124, 73d Cong.), to be expended for acquisition of migratory-bird refuges and for administrative expenses; listed as "permanent" appropriation for fiscal years 1935 and 1936, but beginning with fiscal year 1937 to be carried as a regular annual appropriation, as provided by sec. 4 of act of June 26, 1934.<sup>44</sup> Includes \$19,070 transferred from item of \$47,670 carried in Deficiency Appropriation Act, 1934, for collection and analysis of economic data on agricultural products in connection with reciprocal trade agreements authorized by act of June 12, 1934.<sup>45</sup> Includes \$28,600 transferred from the item of \$47,670 mentioned in note 44.<sup>46</sup> Includes \$164,490 from revolving funds referred to in note 47.<sup>47</sup> Includes \$10,000 provided by Second Deficiency Act, 1935, for establishment of an office in Texas; also includes \$164,490 transferred from revolving funds for classification of cotton and expenses of Cotton Standards Act, which funds have been abolished as such by the Permanent Appropriation Repeal Act of 1934.



TABLE 4.—Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)—Continued

Bureau and item	Appropriation, 1935	Obligations, 1935	Appropriation, 1936
<b>ORDINARY ACTIVITIES—Continued.</b>			
Bureau of Home Economics:			
General administrative expenses.....	\$27,316	\$27,147	\$26,135
Home economics investigations.....	162,956	162,019	167,350
Total.....	190,272	189,166	193,485
Grain Futures Administration: Enforcement of Grain Futures Act.....	190,165	184,816	196,500
Food and Drug Administration:			
General administrative expenses.....	101,429	101,334	100,802
Enforcement of Food and Drugs Act.....	1,225,935	1,225,722	1,540,879
Enforcement of Tea Importation Act.....	38,952	38,688	40,094
Naval Stores Act.....	33,740	33,607	34,700
Enforcement of Insecticide Act.....	201,172	200,819	208,180
Enforcement of Milk Importation Act.....	18,818	18,269	19,241
Enforcement of Caustic Poison Act.....	24,309	24,089	24,741
Total.....	1,644,355	1,642,528	1,968,637
Beltsville Research Center.....			75,000
Total, ordinary activities.....	43,402,584	41,605,569	50,482,208
<b>SPECIAL ITEMS:</b>			
Soil Conservation Service:			
Soil erosion investigations <sup>45</sup> .....	176,175	<sup>45</sup> 176,032	182,210
Plant reserve stations.....	( <sup>49</sup> )		<sup>50</sup> 483,198
Total.....	176,175	176,032	665,408
Forest-fire deficiency (Forest Service).....	<sup>51</sup> 2,348,000	2,315,060	
Grasshopper control (Bureau of Entomology and Plant Quarantine).....	<sup>52</sup> 2,354,893	171,372	
Chinch bug control (Bureau of Entomology and Plant Quarantine).....		54,026	2,500,000
Screwworm control (Bureau of Entomology and Plant Quarantine).....		60,000	480,000
Total, special items.....	4,879,068	2,776,490	3,645,408
<b>FORESTRY RECEIPTS AND SPECIAL FUNDS:</b>			
Refunds to depositors.....	60,000	73,275	( <sup>53</sup> )
National Forest Reservation Commission.....	<sup>54</sup> 6,400	4,867	7,500
Payments to States and Territories (national-forest receipts fund).....	<sup>55</sup> 660,000	821,399	<sup>55</sup> 660,000
Payments to school funds, Arizona, and New Mexico (national-forest receipts fund).....	<sup>56</sup> 28,500	23,242	<sup>55</sup> 28,500
Roads and trails for States (national-forest receipts fund).....		326,476	<sup>55</sup> 328,000
Cooperative work (contributed funds).....	<sup>56</sup> 2,000,000	674,744	<sup>56</sup> 2,000,000
Total, forestry receipts and special funds.....	2,754,900	1,924,003	3,024,000
Total, all foregoing items.....	51,036,552	46,306,062	57,151,616
<b>PAYMENTS TO STATES (exclusive of road funds and forestry receipts funds):</b>			
Office of Experiment Stations:			
Hatch Act.....	720,000	720,000	720,000
Adams Act.....	720,000	720,000	720,000
Purnell Act.....	2,880,000	2,880,000	2,880,000

<sup>45</sup> \$60,226 obligated by Bureau of Chemistry and Soils, \$61,308 by Bureau of Agricultural Engineering, and \$54,498 by Soil Conservation Service.

<sup>49</sup> Erosion control nurseries financed in 1935 under Public Works funds.

<sup>50</sup> Transferred from Bureau of Plant Industry.

<sup>51</sup> Provided by First Deficiency Act, 1935.

<sup>52</sup> \$25,000 of this amount was reappropriated for 1936 by the Second Deficiency Act, 1935, for conducting grasshopper surveys.

<sup>53</sup> Abolished by Permanent Appropriation Repeal Act, approved June 26, 1934; requirements included under item "Refund of moneys erroneously received and covered", Treasury Department.

<sup>54</sup> Permanent appropriation; beginning in the fiscal year 1936 to be carried as regular appropriation, as provided by sec. 2 of act of June 26, 1934.

<sup>55</sup> Permanent appropriation.

<sup>56</sup> Carried on books of Treasury as trust funds, as provided by sec. 19 of act of June 26, 1934.

TABLE 4.—*Detailed statement, by bureaus and subappropriations, showing regular Department of Agriculture funds for fiscal years 1935 and 1936 (as of Aug. 31, 1935)*—Continued

Bureau and item	Appropriation, 1935	Obligations, 1935	Appropriation, 1936
<b>PAYMENTS TO STATES—Continued.</b>			
Office of Experiment Stations—Continued.			
Bankhead-Jones Act (approved June 29, 1935)-----			<sup>8</sup> \$600,000
Hawaii Station Act-----	\$28,000	\$28,000	30,000
Alaska Station Act-----	15,000	15,000	15,000
Puerto Rico Station Act-----	25,000	25,000	30,000
Total-----	4,388,000	4,388,000	4,995,000
<b>Extension Service:</b>			
Smith-Lever Act (permanent annual)-----	4,676,096	4,676,096	4,686,096
Smith-Lever Act (supplemental)-----	1,580,000	<sup>27</sup> 1,567,362	1,580,000
Bankhead-Jones Act, June 29, 1935-----			<sup>8</sup> 8,000,000
Capper-Ketcham Act-----	1,480,000	<sup>27</sup> 1,474,800	1,480,000
Alaska Extension Act-----	12,000	12,000	12,000
Additional cooperative agricultural extension work-----	1,000,000	<sup>27</sup> 993,000	1,000,000
Total-----	8,748,096	8,723,258	16,758,096
<b>Forest Service:</b>			
Forest-fire cooperation-----	1,573,619	<sup>28</sup> 1,566,605	1,578,632
Cooperative distribution of forest planting stock-----	56,296	55,613	56,376
Total-----	1,629,915	1,622,218	1,635,011
Total, payments to States, as above-----	14,765,011	14,733,476	23,388,107
Total, regular funds, exclusive of road funds-----	65,802,563	61,039,538	80,539,723
<b>ROAD FUNDS (regular):</b>			
Federal-aid highway system-----	8,000,000	<sup>29</sup> 125,000,000	48,559,256
Forest roads and trails-----	1,500,000	1,500,000	7,082,600
Public-lands highways-----		<sup>60</sup> 2,500,000	2,500,000
Roads at Monticello, Va.-----	<sup>42</sup> 30,000	30,000	
Mount Vernon memorial highway-----		<sup>61</sup> 15,867	
Total, road funds (regular)-----	9,530,000	129,045,867	58,141,856
Grand total (all regular funds)-----	75,332,563	190,085,405	138,681,579

<sup>8</sup> Part of \$1,000,000 provided by Second Deficiency Act, 1935.

<sup>42</sup> Provided by Deficiency Appropriation Act, 1934.

<sup>27</sup> Amounts available to States, minus sums States were unable to offset.

<sup>28</sup> Actually \$1,521,869 for payments to States and incidental administrative expenses and \$44,736 for forest-taxation and timber-insurance studies.

<sup>60</sup> Authorized by act of June 18, 1934 to be appropriated for fiscal year 1936, but apportioned to States in 1935 under immediately available authority contained in Agricultural Appropriation Act, 1936.

<sup>61</sup> Appropriated by Agricultural Act, 1936, but apportioned to States in 1935 under immediately available authority.

<sup>62</sup> Obligations during fiscal year 1935 from appropriations made in prior years.

A detailed statement showing all emergency funds available to the Department during the fiscal year 1935 and the amounts obligated thereunder for 1935 and available for obligation in 1936 is set forth in table 5.

TABLE 5.—*Detailed statement of emergency funds available to Department of Agriculture, fiscal year 1935, obligated in 1935, and available for obligation in 1936 (as of Aug. 31, 1935)*

Activity	Total available for obligation in 1935	Obligated, 1935	Available for obligation, 1936
<b>Road construction:</b>			
Emergency Relief and Construction Act of July 21, 1932: Public-lands highways-----	\$33,589	\$25,659	\$7,930
National Industrial Recovery Act:			
Special road grants to certain States (work-relief highways)-----	<sup>1</sup> 900,000	900,000	
Engineering and accounting supervision-----	<sup>2</sup> 238,188	198,355	39,833
Road construction at Beltsville, Md.-----	10,725	10,725	

<sup>1</sup> Balance from original Public Works allotment of \$8,331,000.

<sup>2</sup> Balance from original Public Works allotment of \$250,000.



TABLE 5.—Detailed statement of emergency funds available to Department of Agriculture, fiscal year 1935, obligated in 1935, and available for obligation in 1936 (as of Aug. 31, 1935)—Continued

Activity	Total available for obligation in 1935	Obligated, 1935	Available for obligation, 1936
<b>Road construction—Continued.</b>			
Emergency Appropriation Act, 1935:			
Forest roads and trails.....	\$10,000,000	\$10,000,000	-----
Public-lands highways.....	2,500,000	2,500,000	-----
Road construction at Beltsville, Md.....	<sup>3</sup> 2,239		\$2,239
Emergency Relief Appropriation Act of 1935:			
Highways, roads, and streets.....	200,000,000	200,000,000	-----
Grade-crossing elimination.....	200,000,000	200,000,000	-----
Total <sup>4</sup> road funds.....	<sup>4</sup> 413,684,741	413,634,739	50,002
<b>Agricultural Adjustment Administration:</b>			
Agricultural Adjustment Act of May 12, 1933, as amended:			
Salaries and expenses (sec. 12a).....	<sup>5</sup> 97,412,192	<sup>6</sup> 5,054,142	<sup>7</sup> 92,358,050
Advances to Agricultural Adjustment Administration (sec. 12b).....	<sup>8</sup> 647,024,663	<sup>9</sup> 646,613,730	<sup>10</sup> 570,000,000
Purchase of sugar (Jones-Costigan Act).....	8,000,000	365,536	-----
Jones-Connally Act:			
General expenses, Agricultural Adjustment Administration.....	<sup>11</sup> 149,136,976	<sup>12</sup> 94,509,753	<sup>13</sup> 54,627,223
Kerr-Smith Act: General expenses, Agricultural Adjustment Administration (tobacco).....	1,087,932	<sup>14</sup> 449,947	<sup>15</sup> 637,985
National Industrial Recovery Act:			
Corn-hog adjustment program.....	<sup>16</sup> 24,875,806	24,875,806	-----
Administration of codes.....	<sup>17</sup> 304,000	205,119	98,881
Emergency Appropriation Act, 1935: Purchase and distribution of livestock and seed in drought areas.....	<sup>18</sup> 86,804,400	<sup>19</sup> 84,095,560	-----
Total, Agricultural Adjustment Administration.....	<sup>20</sup> 1,014,645,969	<sup>20</sup> 856,169,593	717,722,139
<b>National Industrial Recovery Act (exclusive of road and A. A. A. funds):</b>			
Public works allotments:			
Physical improvements, etc.....	9,605,253	9,235,122	370,028
Special projects:			
Transferred to Forest Service appropriations.....	1,000,000	896,853	103,147
National Arboretum.....	10,748	10,000	748
Spray-residue investigations.....	153,493	148,423	4,050
Dutch elm disease control.....	569,220	569,220	-----
Barberry eradication.....	384,527	364,527	20,000
White pine blister rust control.....	1,165,688	1,146,188	19,500
Gypsy and brown-tail moth control.....	466,682	448,000	18,682
West Indian fruit fly control.....	31,314	31,314	-----
Total, public works.....	13,386,925	12,849,647	536,155
Acquisition of land for wildlife refuges.....	-----	-----	<sup>21</sup> 4,060,000

<sup>3</sup> Allotment from appropriation "Emergency relief and public works."<sup>4</sup> \$100,000,000 authorized by Agricultural Appropriation Act, 1936, to be expended from funds provided by Emergency Relief Appropriation Act of 1935 for emergency highway construction, in accordance with sec. 1 of the act of June 18, 1934, was obligated in 1934.<sup>5</sup> Balance of original direct appropriation of \$100,000,000 provided by act of May 12, 1933.<sup>6</sup> Includes \$515,798 transferred to other bureaus.<sup>7</sup> Balance of original appropriation of \$100,000,000 (see note 5); \$5,416,958 estimated to be obligated in 1936, including \$1,169,888 for transfer to other bureaus.<sup>8</sup> Includes amounts for administration of Bankhead Cotton Act of 1934.<sup>9</sup> Includes \$57,702,185 transferred to other bureaus; includes \$11,068,771 for administration of Cotton Act.<sup>10</sup> As estimated in the 1936 Budget; includes \$60,551,274 transferred to other bureaus; includes \$6,000,000 for administration of Cotton Act.<sup>11</sup> Balance of original appropriation of \$150,000,000.<sup>12</sup> Of this amount, \$21,409,060 was transferred to other bureaus, including \$21,344,682 to Bureau of Animal Industry for removal of diseased and surplus livestock.<sup>13</sup> Of this amount, \$19,402,910 was transferred to other bureaus, including \$19,327,825 to Bureau of Animal Industry.<sup>14</sup> Includes \$264,616 transferred to other bureaus.<sup>15</sup> Includes \$404,000 transferred to other bureaus.<sup>16</sup> Balance of original allotment of \$37,000,000.<sup>17</sup> Balance of original allotment of \$554,000.<sup>18</sup> Allotment from appropriation "Loans and relief in stricken agricultural areas."<sup>19</sup> Includes \$1,151,983 transferred to other bureaus.<sup>20</sup> Exclusive of \$22,500,000 advanced by Secretary of Treasury out of \$100,000,000 fund provided by Emergency Appropriation Act, 1935, for protection of title to cotton (carried as an appropriation of the Treasury Department).<sup>21</sup> Part of \$6,000,000 appropriated by act of June 15, 1935, out of \$3,300,000,000 authorized by National Industrial Recovery Act of June 16, 1933, leaving \$1,940,000 available for obligation in 1937.

TABLE 5.—*Detailed statement of emergency funds available to Department of Agriculture, fiscal year 1935, obligated in 1935, and available for obligation in 1936 (as of Aug. 31, 1935)*—Continued

Activity	Total available for obligation in 1935	Obligated, 1935	Available for obligation, 1936
National Industrial Recovery Act (exclusive of road and A. A. A. funds)—Continued.			
Civil works projects (direct allotments):			
Physical improvements (Forest Service).....	\$17,708	\$17,708	-----
Rural tax delinquency, farm mortgage, and land-value studies (Agricultural Economics).....	189,557	164,339	-----
Rural housing survey (Home Economics).....	66,141	47,415	-----
Total, civil works.....	273,406	229,462	-----
Emergency conservation work (direct allotments):			
Acquisition of additional forest land.....	<sup>22</sup> 4,429,827	\$4,429,827	-----
Investigation of land poisoning by selenium (Chemistry and Soils).....	17,834	13,693	-----
Purchase and rental of land for wildlife refuges.....	1,000,000	985,000	-----
Total, emergency conservation.....	5,447,661	5,423,520	-----
Soil erosion:			
Physical improvements.....	5,067	4,965	-----
Erosion control nurseries.....	<sup>23</sup> 521,374	485,189	\$36,185
Soil erosion service.....	<sup>24</sup> 8,910,982	8,577,340	333,642
Total, soil erosion.....	9,437,423	9,067,494	369,827
Total, National Industrial Recovery Act (exclusive of road and A. A. A. funds).....	28,545,415	27,575,123	4,965,982
Emergency Appropriation Act, 1935 (exclusive of road and A. A. A. funds):			
Soil erosion service.....	<sup>25</sup> 4,000,000	2,112,926	1,887,074
Educational phases of drought adjustment programs (Extension Service).....	<sup>18</sup> 3,100,000	1,900,000	-----
Purchase of surplus cattle (Animal Industry).....	<sup>18</sup> 1,875,600	646,231	-----
Establishment of shelterbelt in Great Plains region.....	<sup>26</sup> 1,000,000	908,089	-----
Control of Japanese beetle, St. Louis, Mo. (Entomology and Plant Quarantine).....	<sup>18</sup> 65,000	64,000	-----
Physical improvements.....	<sup>3</sup> 172,936	147,875	25,061
Acquisition of additional forest lands (emergency conservation work).....	<sup>3</sup> 11,035,000	11,035,000	-----
Restoration, improvement, and development of wildlife refuges.....	<sup>3</sup> 2,500,000	2,115,815	-----
Total, Emergency Appropriation Act, 1935 (exclusive of road and A. A. A. funds).....	23,748,536	18,929,936	1,012,133
Emergency Relief Appropriation Act of 1935 (exclusive of road funds): <sup>27</sup>			
Administrative and legal expenses incident to acquisition of forest and wildlife refuge lands.....	900,000	744,584	900,416
Acquisition of additional forest lands.....			12,000,000
Physical improvements, reforestation, etc., on national forests and adjacent private lands.....	<sup>28</sup> 15,000,000		15,000,000
Physical improvements at various Department experiment stations.....			116,117
Restoration, improvement, and development of wildlife refuges.....			266,289
Soil erosion service.....	27,500,000		27,500,000
Elimination of cattle fever tick.....			1,454,000
Eradication of liver flukes in sheep and cattle.....			200,000
Development of a method of weather forecasting.....			17,700
Bureau of Entomology and Plant Quarantine for:			
Dutch elm disease eradication.....	250,000	48,563	201,437
Scouting for and eradication of elm trees infected by Dutch elm disease, in cooperation with States.....			2,480,000
Citrus canker eradication.....			140,500
Control of phony peach disease.....			831,563

<sup>3</sup> Allotment from appropriation "Emergency relief and public works."<sup>18</sup> Allotment from appropriation "Loans and relief in stricken agricultural areas."<sup>22</sup> Balance of original allotment of \$18,965,000.<sup>23</sup> Balance of original Public Works allotment of \$630,000.<sup>24</sup> Balance of original \$10,000,000 Public Works allotment to Interior Department for soil-erosion prevention transferred to Department of Agriculture (Soil Conservation Service).<sup>25</sup> Allotment to Soil Conservation Service from appropriation "Emergency relief and public works."<sup>26</sup> Allotment to Forest Service from appropriation "Loans and relief in stricken agricultural areas"; includes amounts transferred to other cooperating bureaus.<sup>27</sup> Received to Aug. 31, 1935.<sup>28</sup> Including \$1,172,500 for administrative expenses.



TABLE 5.—Detailed statement of emergency funds available to Department of Agriculture, fiscal year 1935, obligated in 1935, and available for obligation in 1936 (as of Aug. 31, 1935)—Continued

Activity	Total available for obligation in 1935	Obligated, 1935	Available for obligation, 1936
Emergency Relief Appropriation Act of 1935 (exclusive of road funds)—Continued.			
Bureau of Entomology and Plant Quarantine—Continued.			
Control of peach mosaic.....			\$47,920
Control and prevention of spread of brown-tail moth.....			960,000
Control and prevention of spread of gypsy moth.....			2,778,000
White pine blister rust control.....			6,328,735
Barberry eradication.....			2,358,920
Locating and destroying <i>Thurberia</i> plants.....			167,474
Locating and destroying wild cotton plants.....			91,200
European corn borer survey.....			116,000
Administrative expenses in connection with foregoing allocations.....			120,000
Total, Emergency Relief Appropriation Act of 1935 (exclusive of road funds) <sup>27</sup> .....	\$43,650,000	\$793,147	<sup>29</sup> 74,076,276
Act of Aug. 24, 1935:			
An amount equal to 30 percent of gross customs receipts collected Jan. 1 to Dec. 31, 1934, to encourage the exportation of agricultural commodities, etc. (sec. 32).....			<sup>30</sup> 92,111,741
Elimination of diseased dairy and beef cattle (sec. 37).....			10,000,000
Total, act of Aug. 24, 1935.....			102,111,741
Puerto Rico trust funds (allotments from sugar processing tax collections in Puerto Rico, authorized by sec. 15 of Agricultural Adjustment Act, as amended by Jones-Costigan Act of May 9, 1934):			
Experiments in the propagation and breeding of tropical plants, and studies of domestic animal parasites (O. E. S.).....	113,000	111,402	1,598
Soil surveys in Puerto Rico.....	15,000	12,594	27,406
Investigation of insect pests in Puerto Rico.....	93,000		93,000
Soil-erosion survey of Puerto Rico.....	82,000		82,000
Payments to contracting producers in connection with adjustment of sugarcane production in Puerto Rico (A. A. A.).....	2,250,000		2,250,000
Total, Puerto Rico trust funds.....	2,553,000	123,996	2,454,004
Hawaii trust funds (allotments from sugar processing tax collections in Hawaii, authorized by sec. 15 of Agricultural Adjustment Act, as amended by Jones-Costigan Act of May 9, 1934):			
Eradication of liver fluke in Hawaii (O. E. S.).....			40,000
Taro investigations in Hawaii (O. E. S.).....			50,000
Soil surveys in Hawaii.....	15,000	4,070	10,930
Development of methods for control of fruit flies in Hawaii.....			80,000
Total, Hawaii trust funds.....	15,000	4,070	180,930
Grand total, emergency funds.....	<sup>31</sup> 1,526,842,661	<sup>31</sup> 1,317,230,604	903,473,209

<sup>27</sup> Includes \$42,856,853 balance from 1935 allocations and \$31,219,423 additional allocated in fiscal year 1936.<sup>30</sup> Estimated.<sup>31</sup> Exclusive of approximately \$65,000,000 for work of Civilian Conservation Corps on national forest and other lands, financed under Emergency Conservation Act funds made available to War Department.

In table 6 the obligations incurred during the fiscal year 1935 for regular work are classified by types of activities (research, extension, eradication or control, regulatory work, and service activities).

TABLE 6.—*Obligations under regular appropriations, fiscal year 1935, classified by types of activity*

Type of activity	All objects except road funds and payments to States for experiment stations, extension work, and cooperative forestry activities <sup>1</sup>		Payments to States for experiment stations, extension work, and cooperative forestry activities <sup>2</sup>	Road funds	Total	
	Amount	Percent			Amount	Percent
Research.....	<sup>3</sup> \$12,619,050	<sup>4</sup> 27.3	<sup>5</sup> \$4,388,000	-----	<sup>6</sup> \$17,037,050	8.9
Extension.....	1,407,795	3.0	<sup>6</sup> 8,723,258	-----	10,131,053	5.3
Eradication or control of crop and animal pests.....	4,703,850	10.2	-----	-----	4,703,850	2.5
Regulatory work.....	10,881,350	23.5	-----	-----	10,881,350	5.7
Public-service activities.....	16,708,753	36.0	<sup>7</sup> 1,577,482	-----	18,286,235	9.6
Road construction.....	-----	-----	-----	<sup>8</sup> \$129,045,867	129,045,867	68.0
Total.....	46,350,798	100.0	14,688,740	129,045,867	190,085,405	100.0
Percentage of total for regular work.....	24.3	-----	7.7	68.0	100.0	-----

<sup>1</sup> Includes ordinary activities, special items, and forestry-receipts funds.

<sup>2</sup> Exclusive of payments to States from road funds and forestry-receipts funds.

<sup>3</sup> Exclusive of \$459,000 for highway research (paid from regular road funds); includes \$44,736 from item "Forest-fire cooperation" for forest taxation and timber insurance research.

<sup>4</sup> 6.6 percent of total for regular work.

<sup>5</sup> Payments to States, Hawaii, Alaska, and Puerto Rico for agricultural experiment stations.

<sup>6</sup> Payments to States, Hawaii, Alaska, and Puerto Rico for cooperative agricultural extension work.

<sup>7</sup> Consists of \$1,521,869 paid to States for cooperative forest-fire prevention and \$55,613 for cooperative distribution of forest planting stock.

<sup>8</sup> Includes \$450,000 for highway research.

In table 7 are shown the obligations incurred for research work over the 5-year period 1932-36, figures for the latter year being estimated. The table gives separately the amounts directly available to the Department and Federal-aid payments to State agricultural experiment stations.

TABLE 7.—*Department of Agriculture regular funds allocated to research, fiscal years 1932, 1933, 1934, and 1935, and estimated for 1936*

Activity	1932	1933	1934	1935	1936 (estimated)
Weather Bureau.....	\$215,100	\$167,575	\$130,900	\$169,600	\$176,000
Bureau of Animal Industry.....	1,243,217	1,107,027	1,031,076	1,064,272	1,218,390
Bureau of Dairy Industry.....	725,472	584,946	539,884	571,000	649,297
Bureau of Plant Industry.....	4,868,676	4,003,569	3,470,400	3,821,839	4,455,217
Forest Service.....	2,372,269	1,748,613	1,182,738	1,085,250	1,634,737
Bureau of Chemistry and Soils.....	1,550,006	1,331,025	1,211,404	1,098,963	1,335,772
Bureau of Entomology and Plant Quarantine.....	2,582,740	2,153,147	1,805,072	1,763,502	2,056,261
Bureau of Biological Survey.....	302,446	287,812	262,182	271,982	328,876
Bureau of Public Roads (highway research paid from road funds).....	496,790	366,068	400,000	450,000	450,000
Bureau of Agricultural Engineering.....	570,990	511,379	401,831	333,197	392,585
Bureau of Agricultural Economics.....	1,845,437	1,492,892	1,318,771	1,306,447	1,468,351
Bureau of Home Economics.....	236,452	189,498	173,116	189,166	193,485
Office of Experiment Stations (exclusive of payments to States).....	361,283	218,612	196,879	212,840	1625,546
Soil Conservation Service.....	(2)	(2)	(2)	176,032	182,210
Beltsville Research Center.....	-----	-----	-----	-----	75,000
General Department administration, including pro rata of publication, legal, and library work.....	835,985	642,918	627,333	584,960	649,812
Total.....	18,206,863	14,805,081	12,751,586	<sup>3</sup> 13,099,050	15,891,539
Payments to State and Territorial experiment stations for research under Hatch, Adams, Purnell, and Bankhead-Jones Acts.....	4,357,000	4,374,000	4,381,000	4,388,000	<sup>4</sup> 4,995,000
Grand total.....	22,563,863	19,179,081	17,132,586	17,487,050	20,886,539

<sup>1</sup> Includes \$400,000 for special Department research authorized by Bankhead-Jones Act of June 29, 1935.

<sup>2</sup> Soil-erosion investigations conducted prior to 1935 are included in total for Bureaus of Chemistry and Soils and Agricultural Engineering; soil-erosion work as affecting the national forests is covered in the totals of the Forest Service.

<sup>3</sup> This total includes \$450,000 for highway research, paid from regular road funds (not included in table 6).

<sup>4</sup> Includes \$600,000 authorized by Bankhead-Jones Act for payments to States and Territories.



## INCOME FROM DEPARTMENT'S ACTIVITIES

During the fiscal year receipts accruing incident to the ordinary operations of the Department (that is, exclusive of tax collections) totaled \$11,102,415, and fines imposed by courts in connection with the enforcement of regulatory laws amounted to \$87,581, as follows:

Receipts:	
Deposited to credit of miscellaneous receipts fund:	
National-forest receipts:	
Timber sales.....	\$1,708,734
Grazing fees.....	1,151,153
Other business on national forests.....	431,425
	\$3,291,312
Contributions from private cooperators, appropriated as a special fund (cooperative work, Forest Service) for various activities on the national forests and privately owned timberlands.....	
	700,933
From other sources.....	1,404,313
	5,396,558
Deposited to credit of applicable funds of Department:	
Fees for classifying cotton, deposited to credit of revolving fund for conducting that work.....	17,451
Reimbursement to various Department appropriations for expenditures made therefrom.....	5,688,406
	5,705,857
Total.....	11,102,415
Fines: Fines imposed by courts in connection with violation of statutes intrusted to Department for enforcement.....	87,581
Total.....	11,189,996

## DIVISION OF ACCOUNTS

In compliance with the provisions of the Executive order of June 10, 1933, as amended, consolidating all disbursing activities of the Government in the Treasury Department, the disbursing functions theretofore performed by the Division of Accounts and Disbursements of the Department of Agriculture were transferred to the Division of Disbursement, Treasury Department, on June 1, 1934. As it was considered essential to continue in the Department of Agriculture a central controlling record of the appropriations and funds administered by the Secretary of Agriculture, or under his direction by the various bureaus of the Department, and as it was also considered highly desirable that vouchers scheduled for payment and collections scheduled for deposit by the various bureaus should clear to the Division of Disbursement through one central channel for the entire Department, the departmental accounting and related activities previously performed by the Division of Accounts and Disbursements were transferred, effective on the same date, to the Division of Accounts under the newly created Office of Budget and Finance.

The controlling departmental appropriation and fund accounts are maintained by this Division in the manner and form prescribed by the Comptroller General of the United States, to produce the data which it requires for conducting the fiscal business of the Department with the Treasury Department, the General Accounting Office, and the Bureau of the Budget. Among the functions thus performed by the Division are the receipt and recording of appropriation, transfer, and covering warrants issued by the Division of Bookkeeping and Warrants of the Treasury Department, with approval by the Comptroller General, in compliance with the provisions of the Agricultural Appropriation Act and supplemental, special, and emergency appropriation acts, Executive orders, and special legislative provisions, such as section 601 of the Economy Act for the creation of interdepartmental and intradepartmental "working funds"; the recording of the apportionments of these funds and the obligations reported by the various bureaus thereunder; the reporting of these apportionments and obligations to the Bureau of the Budget in accordance with its requirements; the requisitioning of funds for placement by accountable warrants to the disbursing credit of the chief disbursing officer, Treasury Department, the regional disbursing officers operating under his supervision, and the field fiscal agents of the Department who are still functioning in the United States and various foreign countries; the analysis and recording by appropriations, subappropriations, and funds of the payments made by these disbursing officers and the collections deposited by them; the examination of their accounts current, with reconciliation of such differences as are found to exist; and the clearance of all

fiscal information between the Treasury Department, the General Accounting Office, and the various bureau accounting offices of the Department.

In a determined effort to effect much more speedy payment of the salaries of the field employees of the Department than is possible through the Washington disbursing organization of the Treasury Department, arrangements were inaugurated during the second half of the fiscal year for utilizing the facilities of 11 of the 19 regional disbursing offices which had recently been established by the Division of Disbursement throughout the United States. This decentralization of salary payments has been highly successful in accomplishing the desired objective and has been most enthusiastically received by the field personnel affected. Approximately 5,000 field employees are now receiving their salaries from 5 to 15 days sooner than under the former procedure. The decentralization has added very materially to the work of the Division of Accounts, as it has become necessary to establish a separate set of disbursing control accounts for each of the 11 offices now active for the Department. The extra work seems fully justified, however, in view of the great relief afforded the field personnel through prompt salary payments, and it is planned to extend the field-payment system to the remaining 8 regional offices as soon as practicable during the fiscal year 1936.

The work performed by the Division during the fiscal year in the maintenance of the central accounting records involved, in addition to the necessary bookkeeping operations, the examination and submittal to the Division of Disbursement, Treasury Department, for payment of 664,660 administratively approved vouchers and pay rolls amounting to \$523,352,901, and the examination and submittal to the General Accounting Office of 1,312 claims for settlement totaling \$25,835,863. This was an increase of over 60 percent in the number of vouchers and pay rolls and an increase of over 35 percent in amount over the payments made during the fiscal year 1934. These figures do not include \$567,839,790 in rental-benefit payments under the provisions of the Agricultural Adjustment Act, the vouchers for which are not handled by the Division of Accounts.

To make the necessary disbursing funds available to the chief disbursing officer, Division of Disbursement, Treasury Department, for the payment of these vouchers, pay rolls, settlements, and rental-benefit payments, and to enable his regional disbursing officers and the departmental field fiscal agents to disburse over \$119,000,000 additionally for the Department of Agriculture, requisitions were prepared in the Division of Accounts which placed \$1,401,582,166 to credit in 44 separate disbursing accounts, subdivided into 162 checking accounts under specific disbursing symbols.

During the fiscal year 1935 the Division of Accounts received 15,083 schedules of collections from the various bureaus of the Department, including the Agricultural Adjustment Administration, accompanied by 291,307 remittances in the form of checks, drafts, money orders, and cash, totaling \$177,268,121. The work performed in connection therewith consisted of examining the schedules; checking all the remittances with the entries listed on the schedules; examining the remittances to ascertain that they were properly drawn and in negotiable form; endorsing the checks, drafts, and money orders payable to the Treasurer of the United States; transmitting the schedules and remittances to the Division of Disbursement, Treasury Department, for collection and deposit to the applicable appropriation and fund accounts of the Department or the proper general fund revenue accounts; receiving from that Division receipted copies of the schedules; recording these in the bookkeeping record and forwarding them to the bureaus in which they originated. The total amount of the collections received exceeded that for the preceding year by over 20 percent; but the number of schedules was almost three times as great as in 1934, and the number of remittances increased by 250,000 items, principally because of the collections made by the excess cotton tax exemption certificate pool, created in connection with the operation of the Bankhead Cotton Control Act, which involved over 220,000 separate items of remittance.

### BUREAU ACCOUNTING SERVICE

The Bureau Accounting Service, formerly known as the Office of Accounts, Office of the Secretary, was, incident to the organization of the Office of Budget and Finance, as provided by Secretary's memorandum 646, created a division of the latter, effective July 1, 1934. It has continued to function as previously,



conducting the administrative audit and accounting for funds appropriated or otherwise contributed in connection with the broad activities of the Office of the Secretary, the Extension Service (including a large volume of work in connection with activities covered by allotments of funds from the Agricultural Adjustment Administration), the Office of Information, the Grain Futures Administration, the Office of Experiment Stations, the Bureau of Home Economics, and during the later months of the year the Beltsville Research Center. The work necessarily includes continuous study of fiscal procedure, accounting methods, and recording and reporting forms, and involves also analyses of results with a view to advancing the adequacy of methods and accomplishment. The Division maintains detailed records of costs by States, activities, and commodities, broken down by counties and objective classification, and, in addition, segregates and reports travel expenses of Washington personnel by States and by meetings attended, maintains a record of individual travel expenses classified as to transportation and subsistence expenses and average costs per day of travel, and records separately by classes and bureaus all printing and binding costs for use of administrative officers.

A summary of the routine activities of the Division is shown in tables 8 and 9.

TABLE 8.—*Audit work accomplished, 1932, 1933, 1934, and 1935*

Fiscal year	Claims audited	Purchase orders pre-audited	Contracts audited	Items involved
1932.....	15, 115	5, 277	226	167, 481
1933.....	14, 482	5, 227	182	120, 406
1934.....	52, 072	8, 293	158	833, 616
1935.....	85, 053	6, 657	368	1, 253, 678

The volume of work handled in the Administrative Audit Section increased considerably during the year and was much complicated by the large number of Agricultural Adjustment Administration allotments and supplements thereto, with change of periods and appropriations, restrictions on expenditures, and segregating and coding of expenditures by States, counties, and commodities, in addition to the usual objective classification.

TABLE 9.—*Record of pay rolls and miscellaneous items, 1932, 1933, 1934, and 1935*

Fiscal year	Pay rolls prepared	Pay-roll items	Letters of authorization written	Collection claims filed	Transportation requests issued	Bills of lading issued
1932.....	3, 203	51, 802	507	301	5, 785	1, 711
1933.....	3, 434	52, 592	2, 028	293	5, 862	1, 268
1934.....	25, 124	338, 963	9, 959	270	5, 565	1, 935
1935.....	52, 901	734, 279	7, 564	201	7, 780	12, 078

The large increase in 1935 in the number of pay rolls and items as compared with the number the preceding year is due primarily to the Agricultural Adjustment Administration field programs. All pay rolls in connection with these activities required a break down of items by States, counties, and commodities. The average number of employees on the pay roll per month during the fiscal year 1935 was 34,175, the peak enrollment being 96,811 in October 1934, when drought field work was most active.

The work in the Administrative Accounting Section for the fiscal year 1935 showed a substantial increase over that of the previous year, due mainly to the number and complexity of commodity budgets and supplements thereto, involving changes in appropriation symbols, extension and elaboration of records, and incidental increase in monthly and special financial statements

to meet the manifold needs of administrators and to facilitate budget control. Considerable time was also devoted to the maintenance of special records, including an unusually large volume of entries accruing under regular appropriations accounts in connection with the salary restorations of July 1, 1934, and April 1, 1935.

In addition to necessary overhead and collection accounts maintained for the Central Supply Section, the cost accounting in connection with the Department motor-transport service was reassumed by the Division, effective July 1, 1934. This work involved the maintenance of job-cost records for work done by the garage, classified by labor and material costs, stock records for gasoline and other materials issued at the garage, developing cost of maintenance and operation of the Secretary's cars and trucks in the motor pool, and determining cost of reimbursable and nonreimbursable drayage furnished.

The appropriation accounting for the Bureau of Home Economics was also reassumed by the Division on July 1, 1934, and the preliminary work in connection with the establishment of necessary control accounting for funds for the Beltsville Research Center was worked out in cooperation with the General Accounting Office.

To enable administrative officers to comply with regulations of the Internal Revenue Bureau, Treasury Department, salaries of Washington and field personnel receiving in excess of \$1,000 during the calendar year 1934 were computed and reported. Maintenance of individual salary and travel-income accounts essential to future compliance with the regulations will add a considerable burden to the detail work of the Division.

## DIVISION OF PURCHASE, SALES, AND TRAFFIC

### ORGANIZATION AND FUNCTIONS

Incident to an effort during the fall of 1921 to coordinate purchase, traffic, and property activities within the several executive departments and for the Government as a whole, the Bureau of the Budget set up a number of coordinating boards and in that connection requested the appointment, within each department, of a director of purchases, a director of sales, and a traffic manager. In the Department of Agriculture purchases and sales were assigned to the supervision of a single director, and traffic matters were placed under a traffic manager shortly thereafter. By 1923 the Department Board of Awards, which for a number of years previous had negotiated the principal annual and other contracts for supplies in common use by the various bureaus, had been abolished, its functions and other related work being assigned to the office of the director of purchase and sales, who reported direct to the Secretary. In May 1925 further organization changes within the Department transferred these functions and those of the traffic office to a newly created Division of Purchase, Sales, and Traffic, operating under the immediate supervision of a Director of Personnel and Business Administration; and in January 1927 the scope of this Division's activities was extended to include the office and work of the property clerk and purchasing agent of the Office of the Secretary, which office was renamed the Central Stores unit. The functions of this unit, under legislation carried in the Agricultural Appropriation Acts for 1933 and subsequent fiscal years, have since been expanded with the view of an ultimate centralization therein of the supply activities of the Department. No intradivisional changes were involved in connection with the transfer of the entire Division, about a year ago, to the supervision of the Director of Finance.

The work of the Division is at present conducted under four separate but closely related units, namely: A Control and Bid Section, a Traffic Section, a Central Supply Section, and a Surplus Property Section.

The Control and Bid Section directs the general work of the Division. It normally obtains all bids for supplies or services (other than personal) for the use of all bureaus in Washington, and, as far as practicable, for use in the field. It accepts all bids for both Washington and the field, except in the case of the Forest Service and the Bureau of Public Roads, which units are authorized to accept bids or proposals up to \$2,500 in connection with road construction or fire suppression and up to \$1,000 in other cases. The Section also approves all requisitions for job work or supplies where the amount is in excess of \$500; passes on all forest-road projects submitted by the Bureau of Public



Roads for approval by the Secretary; authorizes the purchase of all passenger-carrying motor-propelled vehicles, motion-picture cameras, and projection machines; executes all applications for the withdrawal of alcohol from bonded warehouses; acts as a clearing house for the disposition of all bureau surplus property, and through the Procurement Division of the Treasury Department accomplishes all transfers of surplus property from and to other departments. It distributes to the bureaus schedules and catalogs used in connection with the annual and other awards of the Procurement Division. It also prepares statistics for the Department as a whole covering bureau purchases of passenger-carrying vehicles, and in that connection explains the Department's needs to the Bureau of the Budget and the congressional committees.

The Traffic Section is responsible for the efficient and economic operation of the traffic activities of the Department. Under present procedure it secures from the Traffic Section of the Procurement Division the bulk of the freight rates required by the Department and the routings of such freight shipments as exceed two carloads in amount; but otherwise it must function on its own responsibility and through its own resources in the solution of the Department's traffic problems of whatever character. It conducts such correspondence with the carriers and the general public as may be necessary in that connection; furnishes to bureaus information as to passenger, freight, and express rates; and supplies to bureau accounting officers and individual travelers such information as may be required in effecting adjustment of accounts involving travel by train, steamer, automobile, or air. It also advises bureau shipping and receiving clerks as to the proper nomenclature to be used in billing shipments and the methods of packing and loading necessary to insure the application of proper classifications and rates and assists the bureaus in the expediting of emergency shipments, the institution of tracers, and the preparation of car orders. This Section also arranges for the disposition of unclaimed shipments, investigates damage claims, and secures refunds on unused or partially used tickets; prepares itineraries and gives special advice on train service, routes, and connections; makes sleeping- and parlor-car reservations, and secures tickets and Pullman accommodations; has custody of and issues to bureaus bulk supplies of bills of lading and transportation requests.

The Central Supply Section procures and distributes supplies to all the branches of the Office of the Secretary. Under the centralization plan which is being gradually developed it also serves as the regular general supply office for several of the bureaus and acts in this capacity to a considerable extent for other bureaus and offices of the Department in Washington. It handles all supplies used in the Addressing, Mailing, and Duplicating Section and in the Photographic Section of the Office of Information, billing the various bureaus monthly for such supplies. Under this system vouchering and other accounting work is reduced to a minimum and the cost of such work is properly apportioned. The unit receives and dispatches all freight and express shipments for the Office of the Secretary. It also orders, stores, and distributes all forms in common use throughout the Department, except transportation forms.

The Surplus Property Section controls all transfers of property between bureaus in Washington, D. C., and transfers all such surplus property no longer required by the Department to the Procurement Division of the Treasury Department. The Section also supervises sales of perishable products resulting from the experimental work conducted in Washington, D. C., and at the farms and other experiment agencies located at Arlington, Va., Beltsville, Md., and other points in the vicinity of the District of Columbia, disposition of such products being accomplished usually through the Welfare Store located in the basement of the Administration Building.

#### 1935 ACTIVITIES

The volume of business transacted by the Division of Purchases, Sales and Traffic during the fiscal years 1933, 1934, and 1935 is set out in table 10.

TABLE 10.—*Purchases, sales, and other activities of the Division of Purchase, Sales, and Traffic, 1933, 1934, and 1935*

Item	1933	1934	1935
<b>Bid Section:</b>			
Bid transactions.....number..	2,831	4,122	4,084
Flow of bids:			
First quarter.....percent..	28	13	21
Second quarter.....do..	17	28	18
Third quarter.....do..	20	21	24
Fourth quarter.....do..	35	38	37
Bureau purchase orders in excess of \$500 approved.....number..	70	109	139
Aggregate amount.....dollars..	53,912	346,374	223,591
Forest-road contracts examined prior to approval by Secretary.....number..	145	165	109
Aggregate amount.....dollars..	10,761,152	12,164,018	6,276,077
Value of District of Columbia property transferred from one bureau to another in Department.....dollars..	8,400	4,027	3,648
Initial value of worn-out property transferred to Procurement Division.....dollars..	57,713	26,861	51,839
Food samples destroyed.....number..	2,755	1,997	1,803
<b>Traffic Section:</b>			
Freight routings furnished:			
Less than carload.....do..	4,001	7,085	9,207
Carload.....do..	383	1,337	1,808
Express routings furnished.....do..			5,192
Rates furnished:			
Freight.....do..	6,982	13,363	20,446
Express.....do..	183	181	209
Passenger.....do..	987	8,163	8,700
Parcel post.....do..	80	11	32
Air.....do..	50	0	75
Itineraries furnished.....do..	500	1,043	1,549
<b>Central Supply Section:</b>			
Stock issues during year.....dollars..	154,592	355,284	577,174
Purchase orders (both to maintain stocks and for other activities).....number..	7,079	9,098	13,641
Money value involved, all purchase orders.....dollars..	565,131	1,008,111	2,005,079
Experimental byproducts sold: For deposit to miscellaneous receipts.....dollars..	26,556	28,799	30,676

## BID TRANSACTIONS

For 1935, as was the case for the fiscal year 1934, the number of bid transactions fails to indicate the real volume and importance of this phase of the work of the Division. To obtain a true picture, the 1935 figure (4,084 transactions) must be considered in connection with the total money value involved. When so considered it will be seen that, whereas in 1934 the average contractual obligation for each transaction (\$2,980.83) was remarkably high in comparison with the corresponding figure for any preceding year, the average figure for 1935 rose to \$5,386.88, the total contractual obligations involved being approximately \$22,000,000. Moreover, the special conditions governing advertising and awards in connection with Public Works Administration projects, the application of National Industrial Recovery Administration code provisions during practically the entire year, and the efforts of bidders to secure Government contracts during a period in which outside business continued below normal in amount, all added to the difficulty of the Division in the negotiation of contracts for both supplies and construction work.

## AUTOMOTIVE EQUIPMENT

For the fiscal year 1935 the authorization for the purchase of passenger-carrying vehicles for field work under the regular appropriations of the Department was slightly in excess of \$200,000 and enabled the Department to increase its fleet during the year to approximately 1,589 vehicles. Purchases under emergency funds, it should be noted, increased this number materially. The demand for trucks, also for use in the conduct of emergency activities, to which reference was made in the Division's report for the fiscal year 1934, continued and increased during 1935. It is estimated that at the close of the latter year the Department had in operation, on emergency and regular work, in excess of 31,000 such vehicles. Most of this equipment, however, will be available for use during 1936 under the emergency-relief program, a fact



which should be reflected in increased amounts available for the employment of personnel on emergency projects without unduly restricting productive results in large-scale operations.

### TRAFFIC ACTIVITIES

That emergency activities of the Department during the fiscal year imposed on the Traffic Section a very substantial additional burden of work is clearly shown in table 10. The addition of the Soil Conservation Service to the list of the Department's bureaus and the additional routing, rate, and travel information developed for the benefit of that organization and for the Agricultural Adjustment Administration and the Resettlement Administration have in substantial measure been responsible for the increase.

Among the special developments effected by the Section during 1935 the following may be mentioned: A passenger-tariff file covering rail, boat, and air fares, has been reestablished in the Section and is in constant use in supplying information as to fares to all branches of the Department. During the year, also, a number of adjustments have been secured from railroads in behalf of the Department's travelers who otherwise would have been subject to expense-account disallowances.

### SUPPLY WORK

Progress toward the further centralization of the supply activities of the Department in the Division of Purchase, Sales, and Traffic was made during the course of the fiscal year, as the storeroom activity of another of the major bureaus—the Bureau of Animal Industry—was consolidated with the central organization. In further pursuance of the Department's program of centralizing supply activities, the service of supply for the Soil Conservation Service, transferred from the Department of the Interior to the Department of Agriculture in March 1935, is being cared for by the central organization.

The method of prorating the cost of operation by means of a surcharge on the three major phases of supply work conducted by the Central Supply Section (a procedure established during the fiscal year 1934) was continued during the fiscal year 1935.

In January 1935 the space occupied by the Section's storage and issue unit, on the fourth floor of the Federal Warehouse, was vacated for use by the Procurement Division of the Treasury Department, the Section's activities there being transferred to the South Building where additional space was made available in the subbasement.

Considerable difficulty has been experienced in rendering a fully satisfactory supply service for the reason that capital-stock increases have not kept pace with increased volume of business, and as a result adequate stocks cannot at all times be maintained to fill completely requisitions as received. This defect is now in course of correction. The need for increased capital stock is apparent from the tabular data relating to stock issues during succeeding fiscal years, the stock turn-over having increased from 3.34 in June 1931 to 5.67 in June 1935 without a corresponding increase in capital. Pending an increase in the capital stock, the situation is being partially met by more frequent requisitioning of stock items and more frequent billing for materials issued.

The stocks of the Bureau of Animal Industry, which were absorbed during the course of the year, consisted to a large extent of special printed forms used by that Bureau which were merged with the Section's stock of forms. In addition, the receipt and shipment of all forms for the field activities of the Forest Service were taken over by this Section.

### COORDINATION AND CONTACT WORK

During the fiscal year 1935 the Procurement Division of the Treasury Department abolished the interdepartmental Federal Standard Stock Catalog Board, the interdepartmental Federal Specifications Board, and the Federal Contract Board, as such, transferring the duties of these boards to appropriately named sections of the Procurement Division's organization, but in this connection requested each executive department to nominate a general liaison officer, a technical liaison officer, and a contracts liaison officer to preserve the required degree of coordination between the departments and the Procurement Division in the activities concerned. The Secretary of Agriculture named the Chief of the Division of Purchase, Sales, and Traffic as both the general liaison officer and

the technical liaison officer for the Department of Agriculture. The change in connection with Federal Standard Stock Catalog work, however, was nominal, rather than substantial, in that the old board membership continues as an informal committee, the chief of the Division of Purchase, Sales, and Traffic still representing the Department of Agriculture.

In lieu of the former Federal Specifications Board the Director of Procurement, just after the close of the fiscal year 1935, established a special Federal Specifications Executive Committee with the Director of the National Bureau of Standards as chairman and N. F. Harriman of the Procurement Division as vice chairman and technical secretary, further membership consisting of the technical liaison representatives of the Navy Department, the War Department, the Post Office Department, the Veterans' Administration, and the Department of Agriculture. The chief of the Division of Purchase, Sales, and Traffic thus became a member of the committee, whose duties are to prepare suitable Federal specifications for the use of the departments of the Federal Government when approved and promulgated by the Director of Procurement.









## REPORT OF THE CHIEF OF THE FOOD AND DRUG ADMINISTRATION, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
FOOD AND DRUG ADMINISTRATION,  
Washington, D. C., August 29, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith the report of the Food and Drug Administration for the fiscal year ended June 30, 1935.

Sincerely yours,

W. G. CAMPBELL, *Chief.*

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### INTRODUCTION

The fiscal year 1935, like the preceding one, was characterized by extensive congressional consideration of legislation designed to supplant the Food and Drugs Act of June 30, 1906. In shaping this legislation the congressional committees have sought the cooperation of this Administration. Enforcement work under the Food and Drugs Act and other statutes assigned to the Administration has therefore paralleled legislative drafting and conference activities. S. 5, "a bill to prevent the adulteration, misbranding, and false advertising of food, drugs, devices, and cosmetics in interstate, foreign, and other commerce subject to the jurisdiction of the United States, for the purposes of safeguarding the public health, preventing deceit upon the purchasing public, and for other purposes", which passed the Senate on May 28, 1935, is now under consideration by a subcommittee of the Committee on Interstate and Foreign Commerce of the House of Representatives. This measure contains most of the provisions essential to adequate consumer protection in the food, drug, and cosmetic fields. Such amendments as seem necessary have been submitted to the subcommittee by the Administration. The acute need for legislation of this character and the differences between the proposed law and the present statute were quite fully discussed in the last two annual reports.

Anticipating increased appropriations for the enforcement of the Food and Drugs Act during 1936, which were in part eventually made, and the probable early passage of a more comprehensive food and drug law, the Administration, early in the fiscal year, embarked upon a deliberate plan of reorganization and training with a view to personnel expansion. Key men experienced in enforcement work were designated to devote their attention to training the younger personnel and new appointees in the highly specialized technique of enforcement work. The Administration is now able to take on the additional personnel authorized by its current appropriation without any serious disturbance of its orderly operations.

### ENFORCEMENT STATISTICS ON FOOD AND DRUGS ACT

Although it might have been expected that the interruptions occasioned by training operations would materially reduce the regulatory output, this was not the case. Table 1 presents in condensed form the customary statistical summary of seizures accomplished and prosecutions recommended to the Solicitor's Office. For comparison the corresponding figures for the preceding year are given.

TABLE 1.—*Summary of samples on which prosecutions and seizures were based during fiscal years 1934 and 1935*

Item	Prosecutions		Seizures		Total	
	1934	1935	1934	1935	1934	1935
Food.....	665	637	1,264	1,772	1,929	2,409
Drugs.....	362	327	440	228	802	555
Stock feeds.....	71	65	25	11	96	76
Total.....	1,098	1,029	1,729	2,011	2,827	3,040

It should be pointed out in this connection, as has been done previously, that the figures in the column headed "Prosecution" refer not to the total number of legal actions terminated in the courts during the fiscal year but to the number of alleged offenses committed, and referred to the Solicitor of the Department as bases for prosecutions against responsible shippers. In most instances a number of alleged offenses by the shipper are consolidated in one prosecution action.

Table 2 shows comparable import statistics.

TABLE 2.—*Import actions at port laboratories during 1934 and 1935*

Item	Inspected and refused entry		Inspected and released		Total	
	1934	1935	1934	1935	1934	1935
Foods.....	3,197	2,454	20,081	26,765	23,278	29,219
Drugs.....	1,026	1,063	4,709	4,741	5,735	5,809
Total.....	4,223	3,522	24,790	31,506	29,013	35,028

Table 3 shows in some detail the number and kind of samples collected and examined during the 12-month period as compared with 1934.

TABLE 3.—*Number and kind of samples collected and examined in 1934 and 1935*

Item	1934	1935	Item	1934	1935
Foods:			Drugs:		
Interstate samples.....	11,319	9,868	Interstate samples.....	4,735	6,326
Investigational samples..	8,449	10,475	Investigational samples..	369	262
Import samples.....	23,278	29,219	Import samples.....	5,735	5,809
Total.....	43,046	49,562	Total.....	10,839	12,397
			Total foods and drugs..	53,885	61,959

These samples represented the output of more than 13,000 manufacturers. Somewhat more than 3,000 of these were responsible for some form of violation. The figures in table 3 do not include 207,975 samples of cream from interstate and intrastate sources inspected in cooperation with State and municipal officials.

The samples listed as investigational are those collected without records of interstate or import shipment and frequently represent lots of goods which are not actually within the jurisdiction of the law. They are examined as a guide to possible future regulatory action.

## PROJECT PLANNING

To make the regulatory scheme intelligible some repetition from previous reports is necessary. Food and drug law enforcement is not a hit-or-miss operation. More than 25 years of experience has developed an enforcement technique



calculated to accomplish the best results with a limited budget. When the present law went into effect it was easy for an energetic inspector to sample a large number of adulterated and misbranded products in an extremely short time because gross adulterations and misbrandings were widely prevalent. Such random sampling congested the laboratories with a multitude of samples showing highly varying degrees of violation. In too many cases laboratory technique was not developed to a point where scientific analysis could prove the existence of a suspected adulteration. Sampling without a definite plan was obviously wasteful and against public interest. Moreover, it resulted in differences in the degree of intensity of enforcement in different sections. As experience was acquired the importance became apparent of a very definite system which is designated as the "project plan." Its fundamental principles are: (1) Investigation of the food and drug industries by the field inspection force to acquire information on possible violations; (2) the classification of such violations by the administrative officers in the order of their importance to the public; (3) the development by the staff laboratories in Washington of scientific methods for detecting and successfully proving the violations in court; and (4) simultaneous and uniform action against them throughout the country by the field-inspection and laboratory forces of the various stations of the three food and drug inspection districts.

### TIME SPENT ON DIFFERENT TYPES OF VIOLATION

Food and drug law enforcement is the dominant activity of the Food and Drug Administration. The suppression of practices in the food and drug field constituting menaces to public health requires first attention. Next in importance are adulterations involving the contamination of foods with filth or by decomposition. Numerically, however, those violations which involve economic cheats are in the majority. Because they mean financial loss to the consumer, their regulation is a matter of first importance. They, however, can be taken up only after violations of the first two types have been controlled. Some must be deliberately neglected because of the inadequacy of the available force.

During 1935, 83.6 percent of the working time of the food and drug forces was devoted to interstate traffic and 16.4 percent to imports. A little less than 30 percent of the time was expended on drug products, including crude drugs, pharmaceuticals, proprietary preparations, and veterinary products. This represents an increase of nearly 4 percent over the time devoted to this class of products during 1934. About 18.5 percent of the time was given to fruits and 11.5 percent to vegetables, the bulk of this total of 30 percent going to the spray-residue-control project. This is only slightly less time than was given to this project last year. A trifle under 6 percent was devoted to fisheries products as compared with 8 percent in 1934, but dairy products were given increased attention for reasons which will be later explained, requiring more than 11 percent of the time of the field force as compared with 9 percent in 1934. The remaining time, amounting to approximately 23 percent, represented what could be spared for attention to interstate and import traffic in other types of foods such as alcoholic and nonalcoholic beverages, cereals, confectionery, coffee, tea, eggs, flavoring substances, spices, oils and fats, nuts and nut products, saccharine products, mineral waters, and stock feeds. Incidentally, it may be stated that the character of field-inspection work precludes regularity of hours or definitely limited working days. A very large amount of overtime work is ungrudgingly performed as a matter of course, frequently involving night work under conditions of much discomfort.

Space will permit only a few illustrations of food and drug activities. It seems most convenient to retain the captions employed in the annual reports of the last few years, and to submit these examples under the headings heretofore used.

### FOOD ADULTERATIONS INVOLVING PUBLIC HEALTH

The spray-residue project will undoubtedly continue to be the most important activity under this heading until adequate cleansing processes are universally adopted by the industry or suitable methods of combating insect pests are discovered that do not leave toxic residues on the matured crops. Producers are becoming increasingly conscious of the public-health significance

of this problem. State authorities are taking a more and more active interest in patrolling and regulating the output of their own States, and growers' groups are seriously addressing themselves to constructive programs of systematic spray-control and cleansing operations. At the same time, coordinated plans have been made by Federal and State research bureaus to develop rational spraying programs, to devise more effective cleansing procedures, and to discover and test new and less objectionable methods of insect control. For the time being, however, lead and arsenic sprays continue most in favor as a means of protecting the crops.

The long-established tolerance of 0.01 grain of arsenic trioxide per pound of fruit remained in effect during 1934. The tolerance for lead was reduced to 0.019 grain per pound for the same season, and by announcement of January 24, 1935, to 0.018 grain for the coming season. The tolerance for fluorine of 0.01 grain per pound, established in 1933, was retained.

The number of samples of fresh fruits and raw vegetables analyzed by the Food and Drug Administration for spray residues totaled 6,331 from approximately 3,300 producers. The samples included 5,728 of fresh fruits and 603 of raw vegetables. These totals include both investigational samples collected for the purpose of determining whether surveillance of interstate shipments would be necessary and official samples representing consignments actually moving in interstate commerce. Fruit byproducts such as apple chops, apple butter, fruit pectin, vinegar, fruit preserves, and the like were also analyzed. The number of seizures, based on excessive spray residue, made during the years was as follows:

	<i>Seizures</i>		<i>Seizures</i>
Apples-----	299	Apple butter-----	3
Cherries-----	6	Apple chops-----	1
Crab apples-----	5	Broccoli-----	1
Pears-----	7	Cauliflower-----	16

This large total of 338 seizures is discouraging in contrast with 58 last year and 241 the preceding year. This is particularly true of apples, which, as heretofore, continue to be the commodity requiring most attention. Thirty-four seizures of apples were made in 1934 and 137 in 1933, as compared with 299 in 1935. It is desirable to analyze this situation. Our report for 1934 stated in part:

\* \* \* the industry and State authorities in the apple-producing States of the Atlantic and Pacific coasts and of the Rocky Mountain area have quite generally come to recognize their obligations and have set up effective and comprehensive methods of spray-residue control. The same cannot be said of the apple-producing areas in the Great Lakes region and Mississippi Basin. While there has been some recognition on the part of growers of the legal necessity of producing residue-free fruit and of the more general installation of washing machines, there has been comparatively little control activity on the part of State authorities. An enormous truck traffic has developed, necessitating extensive patrolling operations by representatives of the Food and Drug Administration on the principal highways, for the purpose of sampling truck cargoes and directing action at destination where high-residue fruit was found. Intensive surveillance in this area must be continued indefinitely.

Taking the total number of seizures of apples by sections, we find 48 seizures from the fruit-producing States of the Atlantic coast, 19 from the Pacific and Rocky Mountain States, and the remaining 232 from the Great Lakes and Mississippi Basin States. From the statement above quoted it might have been predicted that this situation would develop. The number of regulatory actions in the central food and drug inspection district increased so materially during 1934 in part at least for the following reasons: In 1933 there was a concerted effort on the part of the industry in that area to restrict and reduce spray applications in an attempt to meet the tolerance without washing. The result was, in general, a lower spray-residue load on the mature fruit but an extremely unsatisfactory control of infestation. Apparently in 1934 growers determined to control infestation without regard to the ultimate residue content. Also, in Michigan, and to a lesser extent in other sections, oil sprays were associated for the first time extensively with lead arsenate. The oil interfered seriously with adequate spray removal. By reason of drought conditions there was a lower removal of residue through natural weathering and the size of the fruit was generally below normal. This would have a tendency to increase the amount of residue per pound of fruit. Unmistakably also our inspectors were able to cover a larger field as they acquired more knowledge of the situation and to exercise more intelligent selection in the collection of samples from suspicious shipments, this resulting in a larger number of legal actions as compared with the number of consignments sampled.



The active interest of State authorities in controlling their output was even more apparent in the eastern and western districts than in the preceding year. The reports show that State officials in the apple belt of the Atlantic Coast States and West Virginia analyzed between 5,000 and 10,000 orchard samples, advising the growers where excessive residues were found and of appropriate methods of cleansing, and embargoing large consignments of fruit against distribution until adequately cleansed. The samples examined under State auspices in the Pacific Coast States and Idaho as a guaranty against shipment of high-residue fruit reached the astonishing total of \$2,500. State embargoes to the number of 2,111, comprising 700,000 bushels, were imposed in these States pending cleaning. Such splendid cooperation by State authorities deserves the strongest commendation and cannot fail to result in far better public protection than can be secured through the unaided efforts of the Food and Drug Administration directed against interstate shipments. It would be unfair not to recognize in these efforts of State authorities a reflection of the attitude of the industry itself which has supported these State officials in a whole-hearted manner. It is significant that some of the fruit-producing States of the Great Lakes and Mississippi Basin section are contemplating the adoption of similar State control measures. Meanwhile, intensive sampling of shipments originating in these States must be continued. This will be accomplished at destination points in the case of rail shipments and by night and day patrols at State borders in the case of truck movements.

The small number of pear shipments found objectionable from the spray-residue standpoint does not indicate that this fruit was neglected. Actually 434 samples of pears were analyzed. Extensive sampling operations covering cherries, crab apples, blueberries, and plums showed in general a satisfactory condition in these fruits so far as spray residue is concerned, a total of 5 crab-apple and 6 cherry seizures being all that was warranted in the control of this phase of the spray-residue problem. Grapes have also been extensively sampled in all districts without the discovery of any objectionable spray-residue conditions. Incidentally the western district has found no instances of the application of arsenicals to vineyards in its territory. Nine detentions of importations of German wines were made, however, in that district because of excessive arsenic.

In the case of vegetables, cauliflower again required corrective action, with a total of 16 seizures, all but 1 originating in New Jersey. Colorado and Long Island, which have heretofore been the source of much high-residue cauliflower, marketed products to which no exception could be taken. Celery and cabbage, in spite of extensive sampling, have been found without objection. The only cases in which action based on excessive fluorine was instituted were 1 seizure of broccoli that showed residue, both of arsenic and fluorine, and 2 of apples.

Although reference has been made above exclusively to seizure actions, it may be stated that 28 prosecution actions for shipment of high-residue fruits and vegetables were reported to the Solicitor during the fiscal year. These actions do not in general coincide with shipments on which seizure has been recommended during the same period since they usually represent the final step in the completion of legal procedure against consignments that have previously been seized.

The perfection during 1933-34 of a delicate analytical method for the estimation of minute amounts of lead in foods made possible a resurvey of the food field. A mass of data on the lead content of foods has been secured which permits drawing two tentative conclusions: (1) Absolute freedom from lead is impossible of attainment in civilized and perhaps even primitive society because of the wide-spread occurrence in natural products of minute though appreciable amounts of this metal in the order of a few thousandths of a grain per pound; (2) while amounts of lead of toxicological significance occur occasionally and sporadically as a result of contamination from many different sources, lead in the form of spray residue, if not adequately controlled, would constitute the major source of lead intake in the American dietary, as far as foods in interstate commerce are concerned.

An example of the sporadic but avoidable occurrence of lead in foods is furnished by certain types of imported canned sardines. Following the publication of reports in British food journals, analyses were made of sardines from every commercial source. Excessive lead was found in numerous import lots and 132 shipments were denied entry. The largest quantities came from Portugal, with smaller consignments from Spain and France. The lead contamination originated apparently in the use of metallic grids coated with a lead-tin mixture in one type of manufacturing process. The detentions resulted in the abandon-

ment of this type of equipment with an immediate reduction in the lead content. Subsequently a smaller content of lead was found in certain canned sardines of both American and foreign origin, traceable to the employment of a type of can, now fortunately almost obsolete, containing some exposed solder or employing a certain type of flux in the sealing process. Discovery of this condition was promptly followed by the complete elimination of this type of container from the sardine-canning industry.

Considerable attention was also given during the year to importations of tea in lead-lined containers. When the tea is not protected by paper or other linings, attrition may introduce considerable quantities of metallic lead into the tea. This is another source of lead in the diet which can be readily eliminated. Thirty-seven shipments of tea were detained. It was found that the metallic contamination could be removed by the employment of careful cleaning processes involving the sifting or aspiration of the tea.

The crab-meat project continued to be troublesome in 1934-35 because of the persistence of insanitary conditions in some of the plants in the Chesapeake Bay area. Four hundred and seventy-three samples from that area, representing 71 packers, were collected and examined. Fifty seizures resulted, representing the product of 22 packers. There is a slow but definite improvement in sanitary conditions in this section, but adequate protection of the public health dictates continued attention to this industry. Fifteen crab-meat packers were operating at Mexican Gulf points. Only one was found to be doing a questionable business. Two shipments of his output were seized.

Although the seizure and prosecution campaign inaugurated a year ago against candies containing alcohol has resulted in their practically complete elimination from interstate commerce, consignments of alcoholic confections from European sources continue to be apprehended. They are invariably refused admission in view of the absolute prohibition in the Food and Drugs Act against alcohol in confectionery. In 1934-35, 25 shipments, usually small, were refused entry. In view of the possible use of such articles by children, they are reported under the public-health heading.

Another type of violation of public-health significance but limited in extent is the attempted importation of consignments of liqueur containing wormwood, a toxic ingredient. Importations aggregating 360 cases of this product, originating in France, were apprehended and required to be exported or destroyed. Poisonous Easter-egg dyes were not found during the current year, although the market for this seasonal product was carefully surveyed during the pre-Easter period.

#### FOOD POISONING

Investigations of alleged food-poisoning outbreaks, which during the year have occurred with unusual frequency, have made extraordinary demands upon the inspection and laboratory forces of the Administration. In some cases investigated there was only a single case of illness, while in others as many as 700 persons were affected. Regardless of the number of persons involved, and whether or not the outbreak is apparently purely local in character, the Administration investigates each case, since until the actual cause of the poisoning is ascertained there can be no assurance that products in interstate commerce are not responsible.

Investigation was made of 73 alleged food-poisoning outbreaks, 44 from March to June 1935, inclusive. These 73 cases were widely scattered in 26 States and the District of Columbia. Samples of the suspected food were collected in 32 cases for laboratory examination. No samples were collected when the epidemiological evidence showed that the case was clearly not one of food poisoning, or when samples were under examination by local officers in whose jurisdiction the cases more properly came, or where no material was available. Foods mentioned as possible carriers of pathogenic bacteria, or their toxins, or of chemical poisons, covered a wide range of products, both canned and unpreserved. Confections, dairy products, eggs, flour, fruits, meats, pastries, sea foods, vegetables, and water were investigated.

Among the cases studied, seven had been diagnosed as botulism and, in each, one or more deaths resulted. One death, occurring in Westchester County, N. Y., was attributed to the use of an imported canned fish product, which had not been sterilized in the can and was intended to be handled under refrigeration. The product in this case had not been stored properly, and was decomposed as evidenced by the reported swollen condition of the container. Fish of this character in hermetically sealed cans but not processed in the cans is regularly imported



in New York during the winter months. It comes in refrigerated ships and dealers in the product in New York understand that it must be kept refrigerated, and it is usually sold to consumers who know that care must be exercised to keep it fit for consumption.

Some 4,000 cases of canned unprocessed fish products are imported annually from Scandinavian countries and Germany. As a rule the fish are packed in salt brine or in an acid medium. As offered for entry the goods are not decomposed and the product, due to the presence of salt and acid, is not likely to develop dangerous toxins. Therefore the product does not seem unduly dangerous as entered and, in fact, is not actionable under the terms of the statute. However, in the rare instances in which conditions in a can are suitable for the development of a toxic organism, there is a possibility of danger if the can is held at suitable temperature for a time before the goods are consumed. Some such combination of circumstances apparently took place in the can said to have been the cause of the death mentioned. An immediate survey was undertaken of all types of unprocessed canned fish in possession of New York wholesalers and an examination of current importations was made. Eleven importers in New York City were visited during the winter months, stocks thoroughly examined for abnormal cans, and sampled for laboratory examination. Fifty-one samples were thus collected. Sixteen current importations were also examined, but the results did not warrant either seizure of the stocks in possession of the wholesalers or detentions of importations.

At the time this investigation was made only fresh stocks were in possession of the wholesalers. Therefore it seemed essential to resume investigations during the warmer months. A resurvey of wholesalers' stocks carried out during the spring months showed that six stocks had begun to deteriorate, although no toxic condition was shown. These were seized. They were packed in sauces of various kinds. The stocks seized consisted of 2,259 cans. Supervision of this type of product is now a continuing one. All importations are examined for swells and detained if swells are found. Wholesale stocks are surveyed rather frequently to see that any which have begun to decompose are seized.

The remaining six botulism outbreaks were ascertained to be caused by the use of underprocessed home-canned foods. As in several previous years, there was no case of botulism from domestic commercially canned foods.

Of the remaining 66 outbreaks investigated, 7 were definitely proven by epidemiological data and laboratory findings to be true food-poisoning cases, while an additional 8 cases, although not definitely proven by laboratory examinations, were in the light of quite conclusive epidemiological evidence very probably food-poisoning outbreaks. In nearly all of these positive cases the contamination responsible for the illnesses took place while the food was in the possession of those preparing it for consumption, and not before or during interstate commerce. In one instance wherein an interstate shipment of cheese was involved as the causative agent, prompt action was taken to embargo and later seize all outstanding stocks of the incriminated product. Evidence to incriminate food was lacking in many of the remaining 51 cases, and in numerous instances brief inquiry disclosed no basis whatever for a conclusion that the illness was due to food.

Among those cases properly recorded as being caused by contaminated food, exclusive of those diagnosed as botulism, it is interesting to note the prevalence of two types of poisoning: (1) That caused by the ingestion of inadequately sterilized or improperly refrigerated food, which, by the very nature of its composition, is an excellent culture medium for bacteria, and (2) that due to extreme carelessness in the handling of household insecticides in the kitchen and pantry.

The first type of food poisoning is vividly illustrated by the spectacular outbreak which occurred in White Plains, N. Y., in April 1935, in which approximately 700 persons were stricken with typical food poisoning, following the consumption of cream- or custard-filled pastries. Other outbreaks of similar nature, but of less extent, involving cream puffs and eclairs occurred elsewhere during the year. Although the source of the contamination could not be found, it was clearly demonstrated in the White Plains cases that the custard filling incriminated contained tremendous numbers of bacteria identified as hemolytic staphylococci, capable of producing potent toxin in the pastries. Frozen eggs from an interstate source originally reported as responsible for the outbreak were definitely exonerated by all investigations.

Although the Administration, under the terms of the Food and Drugs Act, has no legal jurisdiction over practices in establishments preparing such food,

and no control over local distribution, it is believed that those local health officers who have restricted distribution of cream-filled pastries during hot weather, and those who have promulgated and are enforcing stringent regulations covering pasteurization, refrigeration, and sanitary measures surrounding manufacture have acted wisely to prevent recurrence of food-poisoning outbreaks of this character, which in recent years have become so prevalent.

Poisoning from insecticides mixed with food ingredients, such as flour or corn meal, occurred, to the knowledge of the Administration, three times during the year. In one case, at Atlanta, Ga., death followed the consumption of gravy made with flour, to which, in some manner, a large amount of sodium fluoride had been added. Corn-meal mush, in which had been incorporated a fluorine compound, caused illness in Cincinnati, Ohio; and flour containing an arsenical compound added by undetermined means was the cause of illness at East Hartford, Conn. These incidents bespeak the need for greater care in the use of insecticides and rat poisons in the home. The Administration is obviously without authority to control the careless use of household insecticides. Unfortunately, no Federal statute requires that such products bear cautionary or poison legends. Warnings have often been issued through the press, but the frequent repetition of these occurrences indicates that danger from this source cannot be overemphasized.

### FOOD ADULTERATIONS INVOLVING FILTH AND DECOMPOSITION

The Food and Drug Administration maintains the Division of State Cooperation to further effective coordination of the work of Federal, State, and local officials. Perhaps nowhere except in spray-residue work is coordinated control more essential than in the dairy industry. The past year has been characterized by a cooperative regulatory project of great magnitude and of tremendous importance to the dairy industry and particularly to the consumer.

Our last report told of the development of an objective method for establishing the presence of filth in butter, and noted 107 seizures of filthy packing-stock butter. This short intensive campaign was followed up with 45 seizures in the fiscal year 1935. With the close of the year the situation in the packing-stock-butter industry was greatly improved. The second step in the regulatory plan was to extend the work to creamery butter. Thirty-five seizures were made in 1934 because of the presence of filth, and 43 were made during the present fiscal year.

Foreign matter in creamery butter is largely the result of negligence in the handling of cream. Cream for commercial buttermaking is procured from a multitude of small producers, many of whom handle and protect their product in a manner beyond reproach, as they would food intended for their own table. Others, however, among the cream producers, as well as some creamery operators, have little conception of those standards of care and cleanliness which should characterize the handling of any food product. A small proportion of filthy or partially decomposed cream will contaminate the entire output of a creamery. The logical point of corrective attack is the initial source of the cream. Federal jurisdiction alone can accomplish little in this direction since so much of the cream is delivered from intrastate sources. Federal action directed against the relatively small number of interstate consignments of filthy cream must be supplemented by coordinated State and local action against objectionable cream from intrastate sources.

Cooperative arrangements were entered into with enthusiasm by State authorities in the dairy States. Small squads of Federal and State inspectors, accompanied when needful by city authorities, began late in August 1934 systematic visits to creameries while cream was being received. Receipts from all sources were inspected and filthy or decomposed consignments, following State or Federal embargo, were destroyed or denatured to make them unfit for food use. From August 22 to December 6, 1934, inspections were made in 18 States. The equivalent of more than two hundred thousand 8-gallon cans of cream was inspected and approximately 8,000 cans found actionable.

With few exceptions the attitude of the creamery operators was constructive and cooperative. There was a full recognition of the fact that butter of proper food quality can be prepared only from sound cream. There was likewise an agreement that legal action is essential to guarantee the regulation of those members of the industry who are willing to accept unfit cream for butter-making purposes at their own price, thereby forcing the entire industry to their own low level through the inevitable competitive urge. Leaders of the industry,



State dairy bureaus, and the Federal Bureau of Dairy Industry have cooperated constructively by disseminating educational material to creamery operators and cream producers showing how cream may be protected and kept in sound condition and thus retained in a state suitable for butter manufacture and unobjectionable from the standpoint of the law. Another result of this campaign has been the enactment by several States of laws providing for compulsory cream grading and the prohibition of the delivery, sale, or purchase of unfit cream. Unfortunately the inspection forces are too small to permit continuous surveillance. Repeated inspections will be made, however, and criminal prosecutions begun where correction has not occurred. The project has resulted in a notable improvement in the quality of our national butter supply, but the gain can be maintained only by repeated inspection surveys. Like the spray-residue problem, this activity illustrates the utter inadequacy of the force now available for Federal food and drug law enforcement.

Wherever possible, the work already initiated on cream and butter will be extended to other creamery products, notably cheese; condensed, evaporated, and powdered milks; and similar articles. Laboratory methods suitable for proving objectively that unfit materials are employed are now under study.

Tomato products, particularly pulp, puree, and catsup, have required close attention for many years. Tomatoes themselves are subject to insect attack during growth and to invasion by molds, yeasts, and bacteria, which cause rapid decomposition. Manufactured tomato products containing insect fragments or decomposed and rotten vegetable material are adulterated. A microscopic method for the detection and estimation of mold and other evidences of decomposition or filth was developed early in the enforcement of the present law and has become the standard factory-control method used by careful manufacturers to guarantee that their output shall be free from filth or decomposition. During the last season, however, two situations developed illustrating how impossible it is for a food-law enforcing agency ever to regard its task as completed. In Indiana, and to some extent Ohio, Tennessee, and Kentucky, much tomato puree and catsup containing objectionable quantities of spoiled tomatoes were manufactured. There are in this area about 70 manufacturers who do a material interstate business. Analysis of 625 samples of puree and catsup during the season of 1933 showed 10.7 percent to require legal action. During the 1934 season 412 samples were examined and showed 45.2 percent adulterated. The 1933 samples were collected at random during factory inspections by State authorities and our own inspectors and represented a reasonable cross section of the whole industry, including about 100 factories doing little or no interstate business. The 1934 samples were collected with the aim of sampling the output of all manufacturers doing interstate business. The increase in violations can be attributed to a combination of circumstances. Due to the drought, production was limited. The season opened with a very little carry-over from the previous year and a big prospective demand. This led many packers to endeavor to increase their production by exercising less care in rejecting objectionable material. The output of 64 manufacturers was sampled, 38 of whom were found to be shipping illegal goods. Seizures of 168 lots were made and prosecution recommended against the principal offenders on the basis of 51 samples. Certain New York canners were also responsible for distributing adulterated tomato products, resulting in 31 seizures, as compared with 4 in 1934.

Up to the time of writing this report the only one of these seizures which has been contested resulted in a verdict for the Government. Practically all other seizures have been terminated without contest, the goods being released to the manufacturers under bond, after admitting the charges, for the purpose of sorting out and destroying material showing excessive mold counts.

In certain far Western States extensive insect infestation resulted in the manufacture of some tomato products containing insect debris. In the western inspection district there are 145 tomato-manufacturing plants, of which 121 were given attention. The output of 54 of these was found to be in violation in some respect. Three hundred and thirty-four samples were examined, and 91 samples, or in excess of 27 percent, found to be actionable. Thirty-six seizures, totaling 6,552 cases of puree, catsup, and tomato sauce, were accomplished. Nine seizures of the same articles, totaling 1,302 cases, were based on the presence of decomposed tomato material.

Fishery products as usual required much attention. Inspections accorded crab-packing plants have already been described. Approximately 4,500,000 pounds of tullibees and whitefish were imported from Canada through ports

in our central district during the fiscal year. This is a materially greater importation than occurred last year. The Minneapolis and Chicago stations maintained continuous surveillance and examined 1,050 samples. One hundred and five samples, or 10 percent, showed parasitic infestation to a degree justifying exclusion. A total of 421,000 pounds was detained. In the eastern district, the New York and Buffalo stations examined samples from 330 lots, totaling over 500,000 pounds. Of these, 34 lots, aggregating 39,000 pounds, were refused admission. The number of rejections as compared with 1934 is high. During that year 26 lots out of 676 imported (3.8 percent) were found objectionable. It is not possible to account definitely for the increase in detentions except on the theory that new sources of fish were tapped in Canada and that tullibees and whitefish were exported from lakes of questionable character. There are approximately 150 domestic shippers of tullibees and whitefish in the central district who formerly obtained their supplies from the heavily infected Lake of the Woods area. As a result of seizures directed against parasitized fish and successful prosecutions of the shippers, comparatively few shipments of objectionable fish from this area are now made.

The pack of canned salmon produced in Alaska, Washington, and Oregon during the last season by approximately 220 canneries totaled 8,361,990 cases. Last year's pack was one of the largest ever produced and the inspections indicate it was one of the best. As in former years, several inspectors were dispatched to southeastern and southwestern Alaska, visiting practically every cannery in those areas during the packing season. Little or no bad fish was encountered either in Alaska, or Puget Sound, or in the Columbia River. The Seattle station, on which the brunt of the salmon inspection devolves, for the first time in many years was not required to effect a single seizure of canned salmon. The record for the year shows a total of 625 samples examined, representing the output of 134 companies. All were of satisfactory quality. One seizure of a previous year's pack, totaling 432 cases, was consummated in July 1934. This action, however, was based on a misbranding as to vitamin content and medicinal claims and was not because of unfit condition of the salmon. By comparison with 107 seizures in 1933 and 17 seizures in 1934, there is reason for satisfaction at the improvement shown.

Domestic sardines, which are packed only in Maine and California, and which in previous years have required considerable attention because of the use of unfit fish, were found to be in excellent condition during the past season. Extensive sampling and factory inspections disclosed only one lot warranting action on this ground. Prosecutions against two manufacturers for shipments made and seized the preceding year were entered.

Canned mackerel is a product of growing commercial importance in southern California. About 1,250,000 cases were canned in 1934 as compared with 88,000 in 1932, and the former peak of 1929, amounting to nearly 600,000. Widespread demand caused a number of canners, who were not properly equipped, to attempt the business. The peak of packing operations was reached in August and September and the run of fish was too heavy for the inadequate facilities. Two hundred and sixty-nine samples of this canned material, representing the output of 17 packers, were examined, resulting in 19 seizures, aggregating more than 6,000 cases. These goods were the output of six different canners. One seizure involved short weight. The others were based on the presence of partially decomposed fish.

The second largest tuna pack ever recorded, nearly 2 million cases, was in 1934. The great distance at which most of these fish is caught makes it likely that each load received at the cannery may contain some decomposed fish. Surveillance is therefore essential. The State of California is maintaining inspection in these canneries with increasing efficiency. Its work is supplemented by the collection and examination of samples by the Federal inspectors, 109 of which were procured during 1935. Eight seizures on a charge of decomposition resulted, and prosecutions were recommended against the five responsible manufacturers.

As a corollary to the supervision accorded domestically packed tuna, eastern and western district port laboratories inspected 490 lots of canned tuna from Japan, Mexico, and Russia, totaling approximately 3,500,000 pounds. Twenty-two lots, totaling 149,000 pounds, were refused entry because of the presence of unfit fish. As compared with importations aggregating 6,500,000 pounds of this product last year, importations have fallen off considerably. The proportion of rejected material has decreased slightly. Importations of frozen tuna for canning purposes were as usual offered in considerable quantity at the



port of Los Angeles. Five million and thirty-five thousand pounds of this product from Japan were offered for importation, of which 772,221 pounds, or 15.33 percent, were rejected and destroyed because of decomposition. One shipload consigned to Los Angeles, containing 80 tons of the frozen product, was never entered at the port, but was returned to Japan because of the knowledge of the shippers that it contained objectionable fish. While the amount offered for entry was less than last year, when 6,130,000 pounds were offered, the percentage of rejections was slightly greater.

Shrimp canning is an important industry of the States bordering on the Gulf of Mexico and the south Atlantic coast. As was stated in last year's report, an amendment to the Food and Drugs Act, approved June 22, 1934, authorized the Secretary of Agriculture to establish supervisory inspection in fish-canning plants. This amendment was sought and obtained by the shrimp canners, and a report upon it will be made in another section. Because a large proportion of last year's pack was not under this inspection, it was necessary to continue the regulatory surveillance of the uninspected product. Five hundred and ninety-four official samples, representing the output of 70 manufacturers, were collected and examined. Eighty-nine seizures of canned shrimp were accomplished.

The experience of previous years has indicated that dried and shell eggs entering the jurisdiction of the Food and Drugs Act are in general in satisfactory condition. Because of the pressing character of the work on other products, such as sprayed fruits, and cream for buttermaking purposes, only a minimum amount of attention was given to these commodities in 1935. Of 15 samples of shell eggs examined, 2 called for seizure action, demonstrating that this product should be given further attention if the force of the administration were sufficient for that purpose. Frozen eggs were given the usual attention. One hundred and seventy-one samples were examined, representing the products of 41 manufacturers. Ten seizures were effected and five prosecutions recommended. Of the 41 manufacturers given attention the products of 12 exhibited some degree of violation. This condition is by no means satisfactory and will require further attention. In this connection attention is called to the discussion in an earlier paragraph of an alleged food-poisoning outbreak incorrectly attributed to frozen eggs.

Cocoa-bean importations have for years been subjected to examination for the purpose of excluding consignments showing excessive amounts of wormy or moldy beans. The annual importation amounts to between 400 and 500 million pounds. In 1934, 763 lots, aggregating slightly more than 224,000,000 pounds, were inspected, and 6,004,000 pounds, or 2.7 percent, were detained because of a wormy or moldy condition. In 1935 but 398 lots were examined, aggregating nearly 84,000,000 pounds. Nine lots, or 107,000 pounds, which is 0.13 percent of the total amount examined, were forbidden entry. The reduction in the quantity examined was the result of a deliberate discontinuance of the examination of African cocoa beans after finding that the product from that source fully met the requirements of the law. This is due to the adoption by the African producers and handlers of rational methods of preparation and shipment.

Inspection of import consignments of figs and dates continues to be an important obligation. Three hundred and fifty-three lots of figs, totaling 5,768,000 pounds, were inspected, and 78 lots, totaling 855,000 pounds, rejected. Two hundred and fifty-eight lots of dates, amounting to 9,249,000 pounds, on examination revealed 60 lots or 1,947,000 pounds as unfit for entry. As compared with the rejections in 1934, a reduction in quality is indicated.

Attention was given to the products of 100 distributors of nuts in interstate commerce. Eight seizures of shipments of filthy or decomposed products were made, and prosecutions were recommended in the case of three shippers. In the import field, 5,008 lots, totaling 18,283,200 pounds were examined with detention of 120 lots amounting to 1,619,700 pounds. A slight improvement in the condition of the imported product was observed.

Imported condimental seeds continued to require extensive attention because of their contamination with rodent and insect excreta. Approximately 1,900 importations of such products were examined, amounting to almost 27 million pounds, of which 337 lots, or 4,600,000 pounds (17 percent) were found objectionable. While an improvement over last year's situation, when about 25 percent was detained, the conditions are far from satisfactory.

The periodical occurrence of disastrous freezes in the citrus belts with severe damage to the fruit imposes a heavy burden on the food and drug inspection

stations covering the affected areas to make certain that excessively damaged fruit is not distributed. Such a disaster occurred in Florida in December 1934, calling for continuous surveillance of outbound shipments of fruit. The excellent control system adopted by the State authorities, supported by the better part of the industry, held most of the seriously damaged fruit within the State. Only five consignments of citrus fruit were considered sufficiently frost damaged to warrant seizure.

### FOOD VIOLATIONS INVOLVING CHEATS

Space will permit but few illustrations of the forms of violation falling under this heading. Reference was made in our last report to oleomargarine frauds. The responsible agents then reported under indictment have since been tried and convicted or have entered pleas of guilty. Indictments brought against them were based on violations of both the Food and Drugs Act and Internal Revenue Act, and the evidence developed was the joint work of food and drug and internal revenue inspectors. Penalties varied from a fine of \$50 against one individual to one of \$2,000 in the case of one of the corporations involved. The ringleader was committed to the penitentiary for 18 months, while fines or penitentiary sentences were imposed in other cases and then suspended. Immediately following the disposition of these cases some of the same individuals began the distribution of an Italian type of soft cheese adulterated with mineral oil. Their operations were promptly detected, conspiracy indictments found, and pleas of guilty were entered. A fine of \$500 has been imposed on one of the conspirators, while others, including one already serving a penitentiary sentence in connection with the previous conspiracy, will be sentenced at a later date.

The campaign to stamp out the bootlegging of vegetable oils under the names of more expensive ones was continued. Products of 78 manufacturers were covered, compared with 86 in the previous year. Ninety seizures were accomplished, as compared with 74 in 1934. In addition to the prosecutions instituted on 39 shipments last year, 16 criminal actions were instituted on 53 shipments made during 1935.

A new form of adulteration and misbranding entirely economic in character was uncovered in the alimentary-paste industry in the use by certain manufacturers of macaroni products and egg noodles of soybean flour and turmeric. Soybean flour is a wholesome article of food but is not a normal ingredient of macaroni products or egg noodles. Inclusion of these substances in alimentary pastes not only permitted the substitution of low-grade flour for semolina, the wheat ingredient used in the manufacture of the better grades of macaroni, but when the soybean flour was colored with turmeric it was possible to simulate egg noodles of a high egg content. Of 62 manufacturers whose products were investigated, 22 were found to be indulging in this practice. Two hundred and five official samples were collected and 38 seizures instituted. This form of adulteration enables manufacturers to produce a cheap product and sell it at the price of a more expensive one.

Another new development in the food field requiring careful attention is the practice of coloring oranges with a coal-tar dye. It is contended that the fruit so colored is mature and edible but that by reason of its uneven or unsatisfactory natural color it is regarded by the buyer as immature or inferior. The proponents of the use of coal-tar dye insist that the addition of the dye merely gives to the fruit the color associated with maturity in the minds of the purchasing public. This Administration has always believed that the addition of chemicals of any kind to natural articles of food should be discouraged. Under the liberal terms of the Food and Drugs Act, however, the coloring of oranges with a harmless dye can be prohibited only if its use conceals inferiority. If the color does not conceal inferiority, a plain and conspicuous statement of added color is required to be imprinted on the skin of the fruit for the consumer's guidance. A departmental announcement to this effect was issued on July 16, 1934. Fruit colored with coal-tar dye will be carefully watched. If artificially colored fruit not so labeled, or if inferior fruit colored to appear of superior quality is encountered, appropriate action will be taken.

### McNARY-MAPES AMENDMENT

As a result of an appellate court decision holding that the canned food commonly known as "soak dry peas" is a different generic article from ordinary canned peas, a quality standard for canned dry peas was promulgated on Febru-



ary 20, 1935. Specific requirements for the labeling of canned dry peas were laid down.

The third revision of the regulations under this amendment was issued. Aside from the addition of the canned dry-pea standard and certain editorial changes in the interest of clarity, the only important changes were an increase in the "solidity requirements" for canned tomatoes from 45 to 50 percent drained solids and a modification of the fill-of-container requirements for canned peas.

For failure to meet the standards set up and the labeling requirements established for substandard products under the amendment, 51 consignments of canned foods were seized. These represented the output of 22 firms and totaled approximately 30,500 cases, including canned peas, tomatoes, cherries, pears, and apricots. Canned peas headed the list with 28 seizures totaling 21,796 cases, the output of 7 canners. The peas were overmature and ruptured and their labels failed to show their substandard quality. Next in order were canned tomatoes with a total of 16 seizures, amounting to 8,000 cases and representing 9 manufacturers. Excessive peel and poor color due to high percentages of green fruit were the most common causes of action. Three small shipments of pears, from 2 manufacturers, and 1 of apricots were libeled because of irregular size and generally poor quality. Three consignments of cherries, totaling 510 cases, from 3 different packers were seized because of excessive pits. Only a minimum amount of attention to canned-food products could be given under the McNary-Mapes amendment since no specific appropriation for its enforcement has been made. As in previous years an allotment of about \$12,000 was made from the general food and drug appropriation for this project.

### SEA FOOD AMENDMENT

Reference has already been made to the enactment, late in the last fiscal year, of the so-called "sea-food amendment" to the Food and Drugs Act. This amendment, which was sponsored by the shrimp canners, authorizes the Secretary of Agriculture, on application of any packer of sea food shipped in interstate commerce, to assign inspectors to the applicant's establishment to supervise packing operations. The packer is required to bear the cost of inspection and the necessary costs of administration.

The first service under this amendment was inaugurated in 3 canneries in Biloxi, Miss., in September 1934. Service was installed in 7 additional plants the following month. Further applications were made from time to time through the year, until a total of 22 plants received the service in Georgia, Alabama, Mississippi, Louisiana, and Texas.

A total of 300,054 standard cases of 48 cans each were packed under the service, for which the packers paid fees totaling \$37,263.50. The average cost of inspection amounted to approximately 0.25 cent for each can of shrimp. Approximately 8,400 tons of raw shrimp were used for canning, and about 295 tons delivered to the canneries were condemned as unfit.

Under the regulations setting up the service, the canned product packed from wholesome material under sanitary conditions and properly processed and labeled is required to bear conspicuously on the label the statement "Production Supervised by U. S. Food and Drug Administration."

The extensive changes required in the equipment and methods of operation at the time the inspection service was installed indicate clearly the reasons why such a large volume of regulatory operations on canned shrimp was necessary in the past. Many cannery buildings were not screened or otherwise protected against insects and vermin. Practically all plants had to discard such equipment as wooden picking and packing tables, wood blanching tanks, and the like, which could not be effectively cleaned, and replace them with metal or metal-covered wood which could be kept in a sanitary condition. Many plants had no inspection belts over which the shrimp could be inspected as it entered the cannery. Some which had these belts did not have crews of workmen trained to recognize and discard decomposed raw shrimp. Rearrangements had to be made in many factories whereby the shrimp could be kept moving rapidly into cans and delays conducive to spoilage eliminated. In most instances processing retorts had to be equipped with temperature regulators and recording thermometers in order to insure that the product was sufficiently cooked to prevent subsequent spoilage in the can.

These and other changes were required by the regulations to insure the packing of a sanitary, wholesome product. The packers have expressed great pride

in the better conditions now prevailing in inspected plants. These canneries are no longer housed in dilapidated, ramshackle buildings with sour and decayed wooden equipment. The buildings are now practically insect and vermin proof and are continually kept in excellent sanitary condition.

While the law requires payment by each packer of the cost of the service rendered to him, every effort has been made to provide arrangements whereby the small packer will not be placed at a disadvantage with those who operate on a more extensive scale. The regulations provide that two packers may operate alternately within the same cannery or in separate canneries, if not too far distant from each other, thus dividing between them the cost of the one inspector required. Other provisions of the regulations are intended to mitigate the cost to the small packer as much as possible.

Because the heaviest packing season had passed before the service was inaugurated in most of the plants under inspection, only about one-third of the total pack of last season was put up under inspection. While every precaution has been observed to avoid even the appearance of "selling" the service to the packers, since it was obviously the intent of Congress that it be purely voluntary, it appears from the large number of new applications received for service at the beginning of the packing season in August that the bulk of the canned shrimp packed during the current fiscal year will be under inspection.

The sea-food-inspection service represents a distinct innovation in Federal food-law enforcement in that the food manufacturer pays the cost of inspection and is free to accept it or reject it, as he wishes. The service corrects potential violations at their source, as does the Federal Meat Inspection Act of 1906, but that act is mandatory rather than permissive.

While the sea-food amendment does not render inoperative the provisions of the law for criminal prosecution and seizure action on interstate shipments of violative goods, a compliance with the regulations promulgated under the amendment insures the integrity of the products and thus renders the remedial provisions of the act unnecessary. Not only is this advantageous to the packer but the consumer is more effectively guaranteed a sanitary, safe, and wholesome product than can possibly be assured through the enforcement of the other provisions of the act.

### ALCOHOLIC BEVERAGES, INCLUDING MEDICINAL WHISKIES

Only a limited amount of attention was given alcoholic beverages for the reason that no specific appropriation was made for this purpose and general supervision of this industry was in the hands of the Federal Alcohol Control Administration. Cooperative contacts with that organization were maintained and in the majority of cases regulatory actions undertaken against alcoholic beverages were upon its request or upon specific complaints from the industry and consumers. Sixteen seizure actions were effected, involving 4 adulterated and misbranded whiskies and 12 other types of products including brandy, liqueur, wines, and vermouth. The whiskies in general were colored and flavored neutral spirits purporting to be genuine whisky. Among the products libeled was an article which was essentially a carbonated hard cider bottled and labeled to resemble champagne. An ingenious feature of the labeling was that a small, inconspicuous back label stating the composition of the article as required by the Federal Alcohol Control Administration was loosely pasted at one end only to the bottle so that it could readily be detached by the salesman at the time of delivery to the purchaser. There remained on the bottle only the prominent labeling suggesting champagne of foreign origin. The invoice bore a statement advising the dealer that the removal of this back label would remove the difference between this product and the most expensive champagne.

Last year's report described the extensive survey of medicinal whiskies resulting in the seizure of 29 consignments failing to meet the requirements of the United States Pharmacopoeia. Approximately two-thirds of all the so-called "medicinal whiskies" sampled failed to meet the standards of the Pharmacopoeia. A follow-up survey during the current year demonstrated a practically complete compliance with the legal standards. Claims for medicinal use have been removed from the labelings of whiskies which do not meet the rigid requirements of the Pharmacopoeia. Only three seizure actions against substandard medicinal whisky were required during the year.



## ACTIONS ON DRUGS

Medicinal preparations bearing false and fraudulent therapeutic claims formed the basis of 177 seizures, of which 15 were veterinary remedies. One hundred and seventy-four such products, including 21 for veterinary use, were referred to the Solicitor as a basis for criminal prosecutions. Drug preparations other than proprietary medicines and medicinal whisky accounted for 39 seizures; misbranded antiseptics, for 2; alleged reducing substances, for 4; and products misbranded as to vitamin claims, for 6. One hundred and fifteen products in the nonproprietary category were made the basis of criminal prosecutions.

A total of 2,298 samples of products recognized in the Pharmacopœia and Formulary were sampled and analyzed. These included 2,051 pharmacopœial preparations and 247 formulary articles. Of these samples, 1,958 (U. S. P. products, 1,778; N. F. products, 180) or approximately 85 percent met the requirements of the standards.

Apparently stimulated by unsettled economic conditions, the business in salvage or "distressed" merchandise, normally a minor problem, assumed major proportions. Some 55 firms and individuals were found to be engaged in the salvage drug business, making a practice of taking up old stock from druggists' back shelves, for which they exchanged new goods in which they had a jobbing or manufacturing interest. Much old material was also picked up at auctions of bankrupt, fire-damaged, or other distressed stocks. Any market at any price whatever was then sought for the goods so accumulated, with the result that many badly misbranded items long regarded as extinct, some of them actually antedating the Food and Drugs Act, again found their way into interstate commerce. Pharmaceutical extracts, too, involved in such transactions, were found in all degrees of deterioration, constituting a serious and unjustifiable public-health hazard.

Although agents for salvage firms concluded their deals throughout the country wherever bargains could be made, the companies' headquarters were located principally in the Southern States, with Texas leading in the volume of such business done. Miscellaneous lots of 53 adulterated and misbranded items, 27 of them pharmaceuticals, found in interstate commerce, were seized and destroyed on instructions of the Food and Drug Administration during the year. In addition, the cooperation of State officials made possible the confiscation of many other lots where the evidence required to establish Federal jurisdiction was lacking. In Texas, where State officials took the initiative, a rapid and thorough campaign brought the destruction of 28 tons, comprising literally thousands of illegal items. As a result of combined State and Federal activities, two of the largest houses formerly dealing in salvage stocks have discontinued that line, and numerous small operators have turned to fields not within the scope of food and drug legislation.

The usual extensive sampling of anesthetic ether was continued. Representative samples from the three manufacturers who are now producing this article in the United States are collected at frequent intervals. Samples amounting to 1,790 individual containers, representative of 173 shipments, were collected. Only 6 individual containers failed to meet the requirements of the Pharmacopœia. The 3 shipments represented thereby were the output of two manufacturers and were seized. This shows an even better condition than in 1934, when, out of 1,368 individual containers, 7 cans were found to depart from pharmacopœial requirements. As compared with surveys of earlier years when literally hundreds of consignments of ether failed to comply with pharmacopœial requirements, the improvement is remarkable.

Attention to anesthetics has not been limited to ether. One hundred and ninety-one samples of chloroform were collected, of which 180 met the requirements of the Pharmacopœia. Eleven lots that failed to meet the standard were the subject of action. One of the lots against which action was taken was found to contain nitrobenzene, presumably because of the use of the same utensils for filling bottles from a barrel containing chloroform and a nearby barrel containing nitrobenzene.

A number of shipments of nitrous oxide were sampled. Fifteen were satisfactory in every respect. Others, however, contained excessive proportions of uncondensable gases, consisting almost exclusively of nitrogen. While this ingredient does not constitute a health hazard, so far as is known, cylinders of gas sold as nitrous oxide are definitely adulterated and misbranded if a material part of their contents is nitrogen. Four seizures were made.

To a less degree than in the two previous years, ampoule solutions for hypodermic injection have been examined bacteriologically. This work has been reduced in scope because the tests made in previous years have shown a very generally satisfactory condition. During the year 16 samples comprising 333 individual ampoules were examined. One batch of phenobarbital sodium was found nonsterile, and immediate action was taken. All other samples examined were sterile. This type of routine work will continue with particular attention to crystalline and powdered products in ampoules.

Examinations were made to determine the vitamin potency of 33 samples representing 29 different products. Three of these were assayed for vitamins A, B, C, and D, and the remainder for one or more of the vitamins, as circumstances dictated. As a result 6 domestic shipments were seized and steps taken looking toward prosecution in 3 instances. Of 9 import consignments sampled, 5 were denied entry, and 1 was required to be relabeled.

Five hundred and twenty-seven biological assay drugs and drug preparations were examined during the year 1935. The examinations are summarized in tables 4 and 5.

TABLE 4.—*Biological assays of imported crude drugs, fiscal year 1935*

Article	Samples examined	Samples requiring detention and exportation
Aconite.....	7	0
Cannabis.....	1	0
Digitalis.....	26	2
Ergot.....	54	23
Strophanthus.....	8	1
Total.....	96	6

<sup>1</sup> Potency of both samples satisfactory; detained on account of excess acid-insoluble ash.

<sup>2</sup> No physiological test made on 1 sample; refused entry because shipment did not meet physical requirements of U. S. P. X. Potency of other 2 unsatisfactory and denied entry.

<sup>3</sup> Potency unsatisfactory.

TABLE 5.—*Biological assays of domestic drug preparations, fiscal year 1935*

Article	Samples examined	Samples requiring action	Article	Samples examined	Samples requiring action
Aconite.....	55	15	Pituitary body.....	58	1
Digitalis.....	93	3	Squill.....	16	3
Epinephrin.....	63	6	Strophanthus.....	23	1
Ergot.....	119	3	Total.....	431	32
Insulin.....	4	0			

## COMMENTS ON COURT CASES

Two thousand and five hundred notices of judgment describing terminated actions were published during the fiscal year, as compared with 825 in the preceding 12-month period. It should be pointed out again that the number of notices of judgment does not coincide with the number of cases terminated during the same period since the preparation of such notices necessarily lags behind the actual termination of the cases. As has already been stated, a notice of judgment recording a prosecution action quite frequently covers a number of separate offenses by the same shipper. On the other hand, a notice of judgment describing a seizure usually records an action against only one shipment.

It has been stated that seizure action under the law is a worthless gesture comparable to the arrest of a murderer's revolver after it has slain its victim. On the contrary, seizure, as has been well stated by one informed commentator, is comparable to the arrest of a murderer's bullet in flight. While there may be some comfort to the consumer to know that the individual responsible for the sale of poisonous, decomposed, or filthy food has been penalized by fine or imprisonment, it seems so self-evident as to need no argument that his satisfaction will



be greatly enhanced if the Government will continue to apprehend such offensive articles by seizure before they reach his table.

Seizure is the most effective procedure for public protection. A product containing a poison cannot be distributed after seizure unless or until it can be cleansed satisfactorily and effectively under Government supervision and rendered entirely suitable for food use. The release of seized material by the courts for so-called "reconditioning" does not imply reworking filthy, decomposed, or unfit material and thereafter distributing it for food use. Filthy, decomposed, or unfit food material is invariably destroyed. Almost every seizure, however, involves goods packed on different days and distinguished by definite code markings on the containers. Examination of samples representing the various codes serves to show whether any particular code is or is not objectionable. The courts usually hold that the destruction of the sound codes would be unwarranted. Under court orders permitting so-called "reconditioning", no unfit material is allowed to go into consumption. By appropriate sorting processes the sound portion of the shipment is separated from the unsound, the unsound being destroyed under Government supervision.

This is not the place for a detailed discussion of court actions. Some general observations may properly be made, however. The Food and Drugs Act specifically limits the penalty which may be assessed for a first offense against the law to a fine of not exceeding \$200. For a second offense a penalty of not exceeding \$300 or 1 year's imprisonment, or both, may be imposed. Where more than one offense is involved in a prosecution, a penalty not exceeding the maximum may be imposed for each offense. Since traffic in foods and drugs is carried on largely by corporations which cannot be imprisoned, the penalties imposed are almost invariably financial ones. Upon the courts alone the responsibility is placed of determining the amount of penalty to be assessed upon conviction.

The range of penalties disclosed by a study of fines imposed during the past 3 years is remarkable. Fines as low as 1 cent, 5 cents, or \$1, and as high as \$4,500 have been assessed. The higher penalties, of course, followed conviction in a prosecution involving a number of separate offenses. A penalty of 1 cent was imposed for the sale of butter short in weight and low in butter fat. The 5-cent penalty was assessed against a manufacturer of a fraudulent patent medicine recommended for the treatment of such diseases as rheumatism, gout, inflammation of the kidneys, Bright's disease, and diabetes. In this case, it should be stated, the defendant was bankrupt.

By contrast with the 1-cent and 5-cent fines above referred to, a western creamery was penalized \$2,400 for shipping low-fat and short-weight butter, and a self-styled herb doctor of St. Louis was fined \$1,000. A fine of \$4,200 was assessed against a western packer of imitation jams and jellies, and \$4,500 against an eastern manufacturer guilty of distributing substandard citrate of magnesia. It is doubtful if even these larger penalties were commensurate with the damage suffered by the consuming public through the purchase of such illegal products.

A criminal case was tried in Nashville in October 1934 against the manufacturer of a product known as "Germ Destroyer", claimed to have curative effects in the treatment of pulmonary tuberculosis, cancer, asthma, and tuberculosis of the bone. Three other products were also shipped by the same manufacturer, offered for the treatment of tonsillitis and chronic throat trouble, coughs, and croup, and one known as a "liver tonic" for use in nervous indigestion. These medicines consisted essentially of kerosene, turpentine, and cottonseed oil. The Government introduced expert testimony to establish that the preparation Germ Destroyer was not germicidal and that all were worthless as curative agents in the conditions for which they were recommended. Evidence was also produced tending to show that the manufacturer had used forged testimonials recommending his product. The defendant acted as his own attorney and the jury rendered a verdict of not guilty.

A criminal case was brought in Los Angeles in November against the manufacturers of a product known as "Microsan Mosene", labeled in part as "a specific treatment for tuberculosis." Evidence was introduced to show that the worthlessness of the product in the treatment of tuberculosis was known to the defendant and that the product contained tubercle bacilli which might be living when the preparation was taken by the patient. To establish the fraudulent character of the activities of the defendant, who was a woman, it was necessary for the Government to investigate her operations in many sections of the United States and bring witnesses from these places. A verdict

of guilty as charged was brought and the maximum penalty permitted under the act for a first offense was assessed, namely, a fine of \$200. The price of the nostrum was \$25 per half ounce, and it is interesting to note that the sale of eight bottles of this preparation, which might and probably did, in some cases, result in the death of the user, would have equalled the amount of the fine.

A case was terminated against a firm in South Richmond, Va., with a verdict of guilty, in April 1935. This firm had shipped in interstate commerce a product labeled "Bellwood Farms Abortion Treatment", composed of cornstarch and a minute amount of potassium permanganate. Contagious abortion of cattle which causes great loss to farmers and stock raisers every year is not amenable to medicinal treatment but, because the causative organism has a tendency to subside in virulence after ravaging a herd, leaving the animals in a resistant or partially immunized condition (a sequence of events only obscurely understood by most stock raisers), manufacturers of such veterinary nostrums are still able to mulct the farmer. A dozen farmers testified to the effectiveness of this treatment and, although one admitted that subsequent tests showed his cattle still affected with the disease, he announced his intention of continuing the treatment. Veterinarians testifying for the Government, however, convinced the jury that the seeming effects came from the natural chain of events, not from the administration of the treatment. This fraudulent cornstarch product sold for from \$6 to \$12 for a package weighing between 1 and 1½ pounds.

A Federal District Court at New York rendered an opinion on October 1, 1934, upholding the ruling by the Department of Agriculture under the Federal Food and Drugs Act which requires a label statement of any departure from the composition of "official" drug mixtures and a disclaimer that the article in question is an official preparation.

The case at issue was a prosecution based on the interstate shipment of a product labeled "Elixir Terpin Hydrate and Codeine (Special)." The Government alleged the product was misbranded because its composition did not conform to that of the article described as elixir terpin hydrate and codeine in the National Formulary, which, under the Federal law, is the standard for all the drugs it describes. The Government also alleged that the word "Special" in the name of the product did not inform the purchaser that the product contained no sirup and that codeine sulphate had been substituted for the codeine required in the official preparation.

A further charge—namely, that the product did not bear a statement that codeine sulphate is a derivative of opium, as required by regulation—was also upheld. A fine of \$150 was imposed.

The court, in its decision upholding the Government's contention that the article was misbranded, said in part:

The regulations for the enforcement of the Food and Drugs Act, adopted by the Department of Agriculture, have an appropriate provision. Regulation 7 (b) provides:

"A drug sold under a name, or a synonym, recognized in the United States Pharmacopoeia or the National Formulary which does not conform to the standard of strength, quality, or purity for the article as determined by the test laid down therein shall be labeled with a statement to the effect that the drug is not a United States Pharmacopoeia or National Formulary article \* \* \*."

This regulation is interpretive and explanatory of the statute, not an attempted addition, and there is no doubt of its validity. (See *United States v. Antikamnia Co.*, 231 U. S. 654). The mere word "special" is not a statement that the product bearing a Formulary name is not a Formulary article. I am of the opinion that the drug was misbranded in that it was sold by a name recognized in the National Formulary but varying from the standards there laid down.

In June 1935 a pharmaceutical manufacturer was fined \$250 in the Federal District Court at Philadelphia for having shipped a product labeled "Compound Tincture Cinchona" which fell below the legal standard for that article. The active principle, cinchona alkaloids, is required by the United States Pharmacopoeia definition to be present in amounts not less than 0.4 g and not more than 0.5 g per 100 cc. Analysis of the product shipped in this instance showed it to contain 0.38 g cinchona alkaloids per 100 cc.

In its charge to the jury the court stated:

The real question before you is: Did this medicine contain less than the quantity specified in the United States Pharmacopoeia? This law is perfectly fair. It does not require any dealer to put forth a medicine which conforms to the United States Pharmacopoeia, but if he labels it under a name which purports to say that it does comply with the United States Pharmacopoeia, then it must comply. If there is less in its ingredients or if there is more in its ingredients, all the dealer has to do is to say so on his label; say what it does contain so that the person who buys it and pays the price



knows precisely what he is to get, and knows whether or not he gets it. That is all he has to do. If he departs from the required standard, he merely has to indicate that on his labels by saying that it is not in accordance with the United States Pharmacopoeia, but it is something else, and setting forth what that something else is.

A criminal prosecution is pending against a midwestern manufacturer for the shipment of cold tablets in a bulk package to a consignee for repacking. The product contained acetanilid and quinine sulphate. It was alleged to have been shipped under a label which failed to bear a declaration of acetanilid as required by the Food and Drugs Act. It was further alleged that it was represented by the manufacturer to the consignee as containing more acetanilid and quinine sulphate than was found to be present by the Government analyst. The defendant filed a demurrer and motion to quash. The United States District Court for the Northern District of Ohio on March 5 overruled defendant's demurrer and motion to quash, stating in part:

I do not agree with defendant's view that the professed standard of quality must be found in the label on the goods. The information charges that defendant made representations to the consignee by letters of the amount of acetanilid and quinine sulphate contained in the cold tablets; and that the tablets in fact contained less of these drugs than was so represented. The letters contained a professed standard within the meaning of section 8 of the Food and Drug Act (sec. 7 in the text as printed in Department Service Announcement, F. D. 1); and as the cold tablets fell below this standard, they were adulterated within the meaning of the same section and it was unlawful to ship them in interstate commerce.

In this opinion the court has applied to adulteration of drugs the principle enunciated by the Supreme Court in *United States v. Weeks*, 245 U. S. 618, in the case of misbranding, where the Supreme Court held that an article may be misbranded by representations of the vendors, even though the label on the article is in compliance with the law.

A case involving a seizure of a reputed treatment for tapeworms and pinworms in poultry was contested in the United States court at Kansas City in February. Government witnesses testified that the product would be worthless for the removal of tapeworms in poultry and only 10 percent effective for the removal of pinworms in poultry. The court, however, rendered a decision in favor of the claimant, holding that even this degree of effectiveness would have some beneficial effect upon the fowl.

In March the District Court at San Francisco rendered a decision in favor of the claimant in connection with a seizure of apple chops shipped from the State of Washington for exportation to France. The Food and Drug Administration had instituted seizure of these goods when the boat on which they were shipped touched at Oakland, Calif. The charge was made that the chops contained added deleterious ingredients, arsenic, and lead. Eminent pharmacologists testified for the Government as to the danger to health involved in the use of this type of product in the manufacture of food, and certified copies of French laws were submitted bearing on the question of the legality in France of foods containing poisonous substances. The court held, however, that the shipment fell within the proviso of section 2 of the Food and Drugs Act. This proviso declares that no article shall be deemed adulterated or misbranded when intended for export and prepared or packed according to the specifications of the foreign purchaser when no substance is used in the preparation or packing thereof in conflict with the laws of the destination country.

In October 1934, on evidence collected by the Food and Drug Administration, an information was filed in the Federal District Court at Macon, Ga., alleging conspiracy by three men to violate the Federal Food and Drugs Act by falsely labeling and selling "Warm Springs Crystal Compound" as coming from the Georgia resort of that name. One defendant, pleading guilty, was sentenced on October 17 to 1 year in the Federal penitentiary. The other two, entering pleas of not guilty, came to trial in March, were found guilty, and given sentences of 2 years each. Defense motion for a new trial was denied. The crystals did not come from Warm Springs and were only a simple laxative composed of Glauber's salts, similar in action to Epsom salts. They cost only a few cents a pound and were sold for a dollar a pound. The defendants comprised the Warm Springs Crystal Co., which in its literature, its correspondence with agents, and particularly in conversation with customers, sought to use the name Warm Springs to commercial advantage. Salesmen were urged to point out the beneficial effects of the springs. The company and its crystals were disavowed in the beginning by the Warm Springs Foundation as having no connection with the springs other than that the office was set up in the same town. Quantities of Warm Springs Crystal Compound were previously seized

at the instance of this Administration, because of misbranding, at El Paso, Oklahoma City, Los Angeles, San Francisco, Louisville and Paducah, Ky, Cincinnati, and Shreveport, La.

A defendant at Syracuse, N. Y., was convicted and sentenced to 30 days in jail for the shipment of a product consisting largely of cottonseed oil, labeled "Olio Puro d'Oliiva Finissimo" (finest pure olive oil). The product was also short volume. This was a second offense. It is mentioned because of the rarity of prison sentences.

### DEVELOPMENT OF NEW ANALYTICAL METHODS

The most important function of the Washington staff laboratories is the development of methods for the detection and proof of adulteration, capable of demonstrating the violations so conclusively that successful court actions can be sustained. The field is extensive. Certain types of adulteration, known for years, have resisted the efforts of the scientist to devise really conclusive objective methods. The search for such methods is continuous. New forms of adulteration are constantly reported by the field force. These reports immediately suggest the need of new lines of study by staff laboratories.

The spray-residue problem has tested the ingenuity of the chemist in devising procedures capable of coping with its various ramifications. Reference has already been made to the development of a delicate quantitative method for lead. In arriving at the lead content of foods in other than the fresh condition, the possible presence of tin (as in canned foods, to cite only one example) is a serious analytical obstacle. This has been overcome by the volatilization of tin as bromide, and a satisfactory and rather general electrolytic method for lead in foods has been published. Industrial and other laboratories have tested it and have given it hearty endorsement.

Another seriously interfering element is bismuth, but fortunately bismuth seems not to be present in interfering amounts in most foods. It is, however, of serious moment to biological chemists, and certain operations for removing the greater part of bismuth have been incorporated in the above published method.

The reagent dithizone, so successfully applied during last season to the analysis of apples for spray residue, has been made the basis of a novel colorimetric method which promises to make possible the determination with reasonable accuracy of amounts of lead of the order of a few thousandths of a milligram. This is in contrast to a limit of about one-twentieth of a milligram for the recently published electrolytic method. The new method is in course of preparation for publication. It should be of interest to various workers in the biochemical field.

An improved rapid and reasonably accurate colorimetric method for fluorine in the form of spray residue on fruits was made available to the industry. The problem of determining fluorine in foods in general is now under attack. Both ashing and wet-digestion methods of preparation are receiving extensive study. The problem of isolation by distillation methods seems fairly well solved. Since titration methods seems unsatisfactory for the minute amounts usually encountered, an attempt is being made to devise a more sensitive photometer for measuring the pale-yellow colors which the colorimetric procedure yields.

A recent disturbing development in the field of insecticides is the use of sprays and dusts containing selenium for combating the red spider and certain other insect pests. Selenium sprays on citrus fruit and grapes are already used on a commercial scale, and selenium compounds are used on greenhouse vegetables to a limited extent. Unlike other poisonous sprays, the indirect health hazard may be greater than the direct. In other words, there exists the distinct possibility of selenium absorption by the plant through the roots, in which form selenium is recognized to be exceedingly toxic. It has already been demonstrated that the selenium content of the soil may be built up to several parts per million by spraying operations, and that plants grown on this soil may in turn pick up amounts of much greater magnitude. Studies on analytical methods for selenium suitable for court work and on the possible added amounts of this element in plant foods are being pressed.

Because of the occasional use of mercury compounds for root rot in certain vegetables, a method has been devised for determining those minute amounts of mercury which might accidentally reach the edible portions. The method employs the useful reagent dithizone. The earlier method has been modified to



eliminate the interference of copper which is practically always present in vegetable foods. The method is now capable of determining amounts of mercury as low as one-five-hundredth of a milligram in the sample under analysis. It will soon be ready for publication.

A method has been perfected sufficiently sensitive to determine with accuracy a few thousandths of 1 percent of methyl alcohol. Previous methods afforded only an approximation even when methyl alcohol was present in relatively large amounts. The method will shortly be ready for publication, and, in addition to being a means of evaluating the health hazard, should also be useful in detecting adulteration of certain types of wine.

There has existed no unified method for isolating the total fat of foods for the purpose of evaluating the butterfat content. Such a method was worked out and published and will find applicability to a wide variety of foods in which milk, butter, and other dairy products are incorporated.

The published studies on the content of citric, malic, and tartaric acids (free and combined) in 29 fruits, 29 vegetables, and 23 miscellaneous products have borne fruit in the following regulatory fields: (1) The evaluation of the fruit content in various fruit products, including wines, especially in disclosing fruits not normally present or expected in the food; and (2) judgment of the amount of milk solids other than fat in food mixtures, especially baked products.

A greatly improved and simplified method for determining lactic acid in milk products has been published and will be submitted for collaborative study. It will be especially useful in drawing conclusions as to the quality of the milk used. A method has also been devised for measuring the titratable acidity of milk, including that due to acid phosphates, which will have a similar application. A procedure has been devised for estimating the tartaric acid, in the form of nonvolatile esters, present in wine. This is expected to furnish a valuable index of the storage history of the wine.

Because of the increasing tendency to use gums and similar materials in cream and cottage cheese, with the attendant possibility of retaining abnormal amounts of moisture, a method was devised and published for the detection of these "thickeners" in such foods.

Work has been done heretofore to establish correlation between the condition of shell eggs and frozen eggs prepared from them. This field of bacteriological investigation has now been extended to investigate the rate and type of spoilage that may occur in eggs of various grades when permitted to thaw after a period of storage as frozen eggs. The investigation, which is as yet incomplete, includes a study of the bacterial flora throughout the original freezing, storage, and thawing periods, and during subsequent decomposition.

Experimental work was conducted to develop methods of detection of, and criteria of judgment for, decomposition in raw, headless shrimp and dried shrimp. Experimental batches of shrimp were permitted to decompose under observation and were examined physically, bacteriologically, and chemically at various stages of the decomposition. Lots of shrimp, representative of various degrees of spoilage, were dried under commercial conditions. The methods and standards of judgment developed by these investigations are applied in the examination of interstate shipments of these products.

A method for the estimation of insect debris suitable for the examination of canned vegetable products has been developed and applied in regulatory work during the year.

### INSECTICIDE ACT

During the year, 1,431 samples of insecticides, fungicides, and disinfectants of domestic manufacture were analyzed chemically and, where necessary, subjected to microscopic, bactericidal, and field or greenhouse tests. In addition, 348 samples were collected from consignments of insecticides and fungicides offered for importation.

These are classified as follows:

Domestic:	Number of samples
Arsenate of calcium-----	17
Arsenate of lead (paste and powdered)-----	36
Paris green-----	12
Bordeaux mixture and combinations of bordeaux with arsenicals----	59
Lime-sulphur solution and sulphur preparations-----	163
Lubricating-oil-emulsion sprays-----	79
Miscellaneous insecticide and fungicide preparations for agricultural use-----	191

Domestic—Continued.		<i>Number of samples</i>
Preparations for the treatment of mange of animals.....		30
Preparations for lice and fleas on animals (including poultry), and for chicken mites.....		120
Sprays for house flies and for the protection of animals against flies.....		153
Preparations for the control of clothes moths.....		118
Preparations for other household insects.....		74
Disinfectants, germicides, and bactericides.....		198
Sodium hypochlorite disinfectants and related products.....		82
Miscellaneous and fraudulent preparations.....		99
Total.....		1,431
Imports.....		348
Total.....		1,779

One hundred and seventy-eight cases were referred to the Office of the Solicitor for the institution of seizure proceedings or for criminal prosecution of the manufacturer and 26 import shipments found in violation of the provisions of the act were denied entry.

#### AGRICULTURAL INSECTICIDES AND FUNGICIDES

There has been much activity in the development and marketing of insecticides that will avoid the hazard of arsenic and lead residues. Many new preparations intended as substitutes for arsenicals have appeared. Many of these required extensive tests and, while most of them were found to be of value for some purposes, a complete substitute for the arsenicals has not yet been found. There has also been a marked increase in the use of insecticidal tree bands to aid in controlling the codling moth. Likewise, a number of new fungicide preparations, particularly for use against important seed- and soil-borne diseases, have been placed on the market. These must all be subjected to practical tests to determine their limitations.

Surveillance of these agricultural insecticides and fungicides is of major importance. A total of 527 of such preparations for use on plants was tested and 44 of them were found to be in violation of the law and were reported to the Solicitor for prosecution or seizure.

#### HOUSEHOLD INSECTICIDES

The insects which most universally affect man are the common household insects—clothes moths, house flies, mosquitoes, roaches, and ants. The ravages of household insects can be almost entirely eliminated by the use of effective insecticides properly employed. There is much misunderstanding, however, by the average householder as to how an insecticide should be used. It is a common belief that the mere odor of a fly spray or moth preparation will kill or repel these insects. Many of the products on the market have borne grossly misleading claims on their labels, as, for example, fly sprays recommended to be used outdoors or moth preparations to be used against moths in an open closet or room. This has resulted in great loss to the user, a waste of the money spent for the product, and lack of protection from damage. During the year 192 of these preparations have been tested, and 52 cases have been transmitted to the Solicitor for criminal or seizure action.

#### SCREWORM PREPARATIONS

Recently the screwworm has become increasingly important in the South-eastern States, causing very heavy losses among all classes of livestock there. A number of new proprietary preparations for use against the screwworm have been placed on the market. While some of them are properly labeled, a large proportion are ineffective or cause injury to the animals which tends to increase reinfestation. Still others are simply fakes. Special attention is being given these preparations in order to prevent losses to the stock raiser.

#### CAUSTIC POISON ACT

As the result of 8 years of enforcement, there is now a very general compliance with the Federal Caustic Poison Act, which requires that certain specified caustic or corrosive substances and their preparations be labeled with



certain precautionary information. Although continuous routine attention is given to this project, it was necessary to institute criminal or seizure action in only 23 cases.

### IMPORT MILK ACT

While importations of milk and cream were very much restricted during this fiscal year, shippers were required to meet all of the obligations imposed under the Federal Import Milk Act. Entries of such commodities must be covered by adequate permits, which are not issued until satisfactory proof is presented of sound health of the producing animals and sanitary condition of originating dairy farms and pasteurizing plants. Examinations of shipments during this year revealed no cause for revocation of any permit.

### TEA ACT

Under the Tea Act every shipment of tea offered for entry into the United States was sampled and examined with a view to excluding impure or unwholesome tea. Samples are compared with standard samples as selected by the United States Board of Tea Experts and approved and promulgated by the Secretary of Agriculture. Table 6 will show at a glance the results of these inspections as compared with earlier years.

TABLE 6.—*Teas examined and rejected,<sup>1</sup> 1926-35*

Year	Examined	Rejected		Year	Examined	Rejected	
	<i>Pounds</i>	<i>Pounds</i>	<i>Percent</i>		<i>Pounds</i>	<i>Pounds</i>	<i>Percent</i>
1926.....	98,551,814	457,537	0.464	1931.....	87,091,330	49,253	0.057
1927.....	97,595,579	109,708	.103	1932.....	99,587,055	59,321	.100
1928.....	91,105,613	57,121	.062	1933.....	95,818,033	58,159	.040
1929.....	93,593,204	115,084	.123	1934.....	85,777,102	142,146	.166
1930.....	84,732,677	207,884	.245	1935.....	84,222,621	233,347	.277

<sup>1</sup> The rejections are those made by the tea examiners, not the final rejections made by the U. S. Board of Tea Appeals.

### NAVAL STORES ACT

The regulatory work under the Naval Stores Act included the examination of some 318 samples of turpentine, rosin, and paint thinners, and 132 factory inspections. Citations to hearings were issued to 10 concerns, some covering multiple collections, and recommendations for prosecution action were made in 6 instances. Five prosecution cases were terminated. In 3 of these fines were imposed; in 1 the defendant was placed on probation; and in 1 the defendant was acquitted by the trial jury.

Under the service provision of the act there were graded in the South a total of 163,938 barrels and drums of rosin covered by 954 United States rosin grade certificates. The Commodity Credit Corporation, in providing for loans to naval stores producers, has required that rosin offered as collateral at certain interior concentration yards and warehouses shall be Government graded, to insure the correctness of the grades. Of the above total, 42,912 barrels of rosin were thus graded for producers intending to place same under loan. Thirty-five lots of turpentine and seven of rosin were examined and graded under the service section of the act at other points. The total sums claimed by the Administration from those requesting these services amounted to \$10,691.37, all of which is returned to the Treasury as miscellaneous receipts.

Amendments to the regulations for the enforcement of the Naval Stores Act have been promulgated to provide for a new form of loan and sale certificate and the fees for the same, as well as to amend the scale of charges for service-grading of rosin by reducing the fee per barrel on lots of 500 barrels or more offered for grading at any one place and at one time.

Further work has been done on the improved glass color standards for grading rosin developed by the Naval Stores Division. Equipment has been developed for accurate matching of color standards, and a procedure devised for reproducing any number of duplicate standards. The proposed modifications in the color standards were further brought to the attention of the trade in the form of conferences and a circular letter, supplementing previous publications. A

hearing on modification of the United States rosin standards was announced on January 4, 1935, by the Secretary of Agriculture in accordance with the procedure set forth in the Naval Stores Act, and held in Washington on July 16, 1935, for the purpose of further consideration by the trade of the proposed modifications.

The photoelectric apparatus for accurate laboratory grading of rosin samples has proved satisfactory. A paper describing this equipment and its use was read at a meeting of the Optical Society of America. New applications of this instrument to other colorimetric problems in the Department are continually being found.

### CERTIFICATION OF COAL-TAR COLORS

One thousand five hundred and eleven batches of food colors, representing the output of 35 firms, were given routine examination to determine their compliance with the requirements of the food law. Straight dyes, not including repacked colors, amounted to 387,400 pounds. Forty thousand nine hundred and fifty pounds of repacked straight dyes and 313,760 pounds of mixtures were also submitted for certification. During the year 4 batches of straight dyes, 24 batches of repacked straight dyes, and 14 mixtures were refused certification after examination. The amount of coal-tar color certified is the largest ever reported. It indicates a general recognition on the part of the industries using colors that only such products as meet the established certification requirements are suitable for this purpose.

### NEW DIVISIONS ESTABLISHED

The importance of fundamental researches in pharmacology to furnish a groundwork for food-and-drug law enforcement led to the establishment during the year of the Pharmacological Division. A well-trained and competent staff has been appointed. This Division, in addition to carrying on more comprehensive testing of certain medicinal products, will pay particular attention to several relatively new fields of work. There are a number of official drugs for which only biological assay methods are described. These are highly specialized methods and in the enforcement of the Food and Drugs Act it is the obligation of the Administration to sample interstate shipments of these products from all manufacturers. The routine assay of these samples by the official methods is in itself a task of considerable magnitude. Aside from such analyses, however, it is essential that new methods be developed for the identification and evaluation of new types of medicaments which are being exploited. There are now on the market, for example, a large number of glandular preparations purporting to have some remedial value. Some of these are no doubt useful and valuable additions to the drug field. Methods of identifying and determining the strength and purity of these preparations, however, have lagged far behind the need. In order to give proper protection to the ailing public, adequate methods must be worked out without delay by the Division. Studies must be made of the chronic effects of the repeated ingestion in foods of a number of substances known to occur as impurities. Lead and arsenic may be cited as illustrations. In spite of much work in many places there exists no complete body of pharmacological evidence on which tolerances for these substances in food can be established with entire satisfaction. Some authorities consider that the existing tolerances are too lenient, others that they are too severe. The majority who are competent to speak on the subject believe that the public health is reasonably protected by the tolerances now in effect, although they insist that unremitting efforts should be continued to reduce toxic impurities to a minimum in foods. It is universally recognized that more extensive scientific work is highly necessary as a basis for establishing and enforcing definite tolerances.

The recognition of the toxicity of certain poisonous substances now commonly used as insecticidal sprays on growing crops has led to proposals to substitute many other types of insecticides alleged to be less toxic to the consumer. As new spray substances are proposed it is highly necessary to study their toxicity so that the administration can adopt a proper position from the law-enforcing standpoint. This is another field for pharmacological investigation.

In the development of chemistry numerous proposals have been made for the employment of new synthetic products in the food and drug manufacturing industries. Many of these are undoubtedly safe for human consumption and



some may be decidedly advantageous in foods and drugs. The potentiality for harm of some of them, however, is entirely unknown. It is the obligation of the Food and Drug Administration to learn all that can be found out about such products and to take appropriate steps to prevent their use where the possibility of danger exists. This is another obligation of the Pharmacological Division.

The Vitamin Division, which will give similar attention to the growing number of vitamin products in the food and drug field, has also been established. Routine work in this field has been in progress for some years under a small section of the Drug Division. The growing importance of this field, however, dictates the establishment of a separate division with sufficient personnel to cover a far more extended field of work. The vitamin field has been widely exploited. These mysterious substances which give certain essential properties to foods have had an undoubted popular appeal. Manufacturers and advertisers have not been slow to capitalize on this and the market has been flooded with many products of doubtful value, in addition to many of unquestioned importance, from a nutritive standpoint. Testing for vitamins must usually be carried on through animal experimentation and the tests made are long drawn out and tedious. Heretofore the smallness of the force and the character of the tests required have prevented the vitamin section from meeting the real needs of the situation.

### FIELD STATIONS RE-EQUIPPED

In the course of the year food and drug inspection stations at Chicago, Philadelphia, and Baltimore were transferred to new Government buildings at those points. New and modern laboratory equipment has replaced the obsolete and outworn furnishings of the older laboratories, some of which had been in use without any essential replacement since the law went into effect in 1907. In Chicago administrative headquarters of the central food and drug inspection district were also transferred to a new building. The food and drug inspection station heretofore located at Savannah, Ga., was moved to the new Government building at Atlanta. Import supervision, however, is still maintained through the port of Savannah. This station was moved because a more adequate control of interstate traffic was possible at Atlanta than in the previous location of the station.

### COLLABORATION WITH OTHER BRANCHES OF THE SERVICE

The staff and specialized laboratory equipment of the Food and Drug Administration are utilized by other agencies of the Government for the analysis of samples of foods, drugs, and insecticides to determine whether or not they comply with contract specifications or whether they meet the requirements of various statutes enforced by those agencies. Likewise the specialists of the Administration are called upon to render technical opinions in the labeling of such products.

At the request of the Federal Trade Commission, 214 reports were made relating to the therapeutic value of various drugs and devices. The products were under consideration by the Federal Trade Commission to determine whether unfair trade practices were involved in their advertising, labeling, or sale.

In cooperative work with the Post Office Department, medical briefs were prepared in 106 cases and 252 analyses and tests were made of drugs, cosmetics, and devices to determine whether or not their distribution was in violation of the postal-fraud law.

There were examined 2,236 samples of foods, drugs, and insecticides submitted by other establishments of the Government mainly to determine whether or not the products sold to the governmental establishments complied with the purchase specifications. The larger number of samples was submitted by the Veterans' Administration, War Department, Navy Department, Marine Corps, Department of Justice, Treasury Department, and Public Health Service. Other establishments for which analyses were made included the Federal Trade Commission, Panama Railroad Co., Federal Supply Relief Corporation, Bureau of Biological Survey, National Recovery Administration, and Bureau of Agricultural Economics.

















## REPORT OF THE CHIEF OF THE FOREST SERVICE, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
FOREST SERVICE,  
Washington, D. C., August 31, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I transmit herewith the report of the Forest Service for the fiscal year ended June 30, 1935.

Sincerely yours,

F. A. SILCOX, *Chief.*

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### THE QUESTION OF FOREST OWNERSHIP

History affords no case of a recognized land-use problem like that now to the fore in the United States. Civilizations have waxed and waned with their material resources; dwindling means of livelihood have set rolling great tidal waves of migration and have been a prolific cause of domestic disorder, class uprising, and international war; but never before have the people of a great country still rich in the foundations of prosperity sought to forestall future disaster by applying a national policy of conservation—of which planned land use is the central core.

In that policy forest-land use rightfully has a conspicuous place. It has, in fact, had the leading place in defining the issues and presenting them in concrete terms for the public mind to grasp. For conservation as a question of national policy was born in the struggle to attain a sound policy of forestry.

Forest conservation has always had in view as its *raison d'être* human and national needs. It has looked upon forest care as a social tool, not as an end in itself. It has raised the question, in a particular field, of a planned and governed economic course designed to safeguard permanently one of the greatest of our basic resources so that we might through it promote diffused prosperity; stabilize industries, communities, and homes; further economic independence for the small man; and improve the general social and economic welfare. It stood against concentrated private control of the sources of wealth, the economic structure, and the course of government.

From the beginning, too, forest conservation has been intertwined with various phases of the national agricultural policy. The two must always mingle; they deal with the single problem of the most beneficial adjustment of human use, from the standpoint of long-range prosperity and happiness of the great body of American citizens, to the land and water resources available for or affected by tillage, pasturage, and forest practices. Forestry continues to concern primarily human values; continues to exemplify the imperative need for conservation policies to guide land use along lines that will best serve human needs; continues bound in with the readjustments essential for a sound agriculture.

Not until the nineteenth century drew near its close and the frontier neared the vanishing point did the people of the United States begin to see that the land-use policy which had been in effect up to that time called for any amendment. This land policy had a definite social as well as an economic purpose; it gave apparent preference to the small man and sought to build up a democratic citizenry of freeholders. At the same time, it assumed that the self-interest of private owners would bring all land that had any economic possibilities to its best form of use. Accordingly the aim was to hasten disposal of

the public domain. And once the individual owner had acquired title to his little parcel of the public domain, the motive of private gain was confidently expected to assure, in the long run, efficient and permanent land use. But the actual result in the commercially valuable timberlands of much of the South, the Lake States pineries, and the far Western States was far different.

By various devices and by sheer force of circumstances, the intent of the laws designed to convey the public-domain timberlands in small tracts to individuals desiring them for personal and permanent use was frustrated on a gigantic scale. Actually, a man or woman who had entered a timber and stone or homestead claim on land chiefly valuable for its virgin forest could ordinarily cash in on his acquisition only by selling it for consolidation into a much larger holding. Actually, too, the inducement leading to private acquisition of public-domain timberlands was not the prospect of profiting by putting the land itself to use, but the value of the grown timber for exploitation. Hence a strong trend toward a purely temporary occupancy. If after the merchantable timber was cut and removed the land could not be sold, all that was necessary was to stop paying taxes and let it go back, skinned of its value, to public ownership.

So the original policy of land disposal did not meet its social objective. It operated, instead, to create a highly transitory lumber industry; one ever beckoned on to new fields of cheap and abundant virgin timber when its earlier sources of supply began to give out. And it served to stimulate private acquisition of the commercially valuable forests of the public domain, not for any purpose of permanent land use but purely for profit in removing the timber.

Much too late for the best interests of the country, the process of forest disposal eventually began to be checked. Slowly at first, then rapidly for a few years, the still remaining public-domain timberlands were drawn upon to build up the western national-forest system. With considerable readjustments, the western national forests now embrace a smaller total area than in 1910. For restrictions of various kinds have hampered their extension and prevented carrying through, entirely, that policy of permanent public administration of forest lands of the public domain which was to have replaced the earlier policy of alienation. Nevertheless, the great bulk of so much of these lands as had not been passed into private possession before the national forests were successively proclaimed—chiefly by President Theodore Roosevelt—is now included in the public-forest system. But the cream of the western forests—the most valuable stands occupying as a rule the land where timber grows best—was first skimmed for private ownership; the national forests are, by comparison, but culls and residues.

The outcome of all this is a forest situation of which the major outlines can be succinctly sketched. With a total forest-land area of approximately 615 million acres (nearly one-third the land surface of the continental United States) 435 million are in private ownership and 180 million publicly owned. Of this publicly owned forest land, 140 million acres, in round numbers, is under some form of more or less permanent public administration with a view to conserving its usefulness. National forests include 63 percent of it. Nineteen-twentieths of their area (which includes considerable nonforest land) came from public-domain reservations; the other twentieth has been acquired through purchase or exchange, chiefly from private owners though in small part from States. As a rule, these areas have been acquired after lumbering by private timberland owners has greatly depleted—if not butchered—the forest.

Many million acres of forest land formerly in private ownership have drifted or are drifting back into the hands of the public through tax forfeiture to States or counties. This is mostly cut-over or burned-over land in too unpromising a condition to seem worth holding longer as private property. That still more extensive abandonment is in prospect is unquestionable. In short, impermanency as a characteristic of much of our private forest-land ownership, and of the contribution made by that land toward community life, is widely in evidence. But the heart and soul of conservation is a system of land use that will sustain permanent communities and give a comfortable livelihood to the largest possible number of citizens. Public policies of forestry have gone far toward working out this forest-conservation problem on lands definitely owned by the public. The great unanswered question now concerns the future of forest lands in private ownership, and those drifting between public and private ownership through tax delinquency. Ownership of these lands, and use of such resources as they now or may hereafter contain, are extensively unstable. The diminished requirements for agricultural land and the increasing area of



farm lands that have become or are becoming submarginal through soil erosion or loss of fertility from other causes augment the problem.

Of the 435 million acres of privately owned forest land, 150 million acres are in farm woodlands. This part of the problem is relatively simple. Except where the necessity for agricultural readjustments makes farming itself unstable, farm woodland is integrated in permanent farm units, with a relatively high degree of stability of ownership. The chief need is to make available the same kind of knowledge about handling this part of the farm as is extended regarding other farm production—knowledge of where and how to grow the wood crop or establish the shelterbelt, and how best to harvest the crop and market what the farmer does not require for himself. Beyond that, of course, is the need in many regions to give farm holdings the benefit of organized public systems of protection against the spread of forest fires. Both these things are essential, for farm woodlands are too commonly deteriorating. Where treated virtually as wild lands, their full potentialities as sources of increased farm incomes and of forest products, especially of high-quality timber for general consumption, are lamentably unrealized. The farm-forestry problem is then one aspect of the general problem of agriculture in our national economy. It involves public aid to the farmer to enable him to use his land to his own best advantage and that of the Nation.

The nonfarm privately owned forest land includes some 45 million acres of "noncommercial" and 270 million acres of so-called "industrial" forest land. The first is land which, unable to grow tree crops good enough in quality and quantity to be commercially operable under existing or reasonably foreseeable conditions, is consequently under private ownership for some other use, such as pasturage. Here the primary question is whether there are involved such watershed or recreation and wildlife values as may necessitate public ownership. This question also is a relatively simple one. It calls merely for a determination of the facts in individual cases. But for the great area of nonfarm privately owned land suitable for commercial timber growing and now the chief support of the forest industries—amongst which the lumber industry holds the leading place both in value of output and as an employer of labor—the problem is much more complex.

This so-called "industrial" forest land is in large part owned by the industries which convert its supplies of raw material into manufactured products; most of the rest is owned by individuals or companies that expect to sell to those industries. Only an insignificant fraction of the total area of industrial forest land is being handled for sustained yields of forest products. True, the Lumber Code required utilization practices that would keep the land from becoming wholly unproductive; and this was a great gain over the destructive methods previously in general use. And though the code has been declared unconstitutional, a considerable effort is being made to obtain voluntary observance of its restrictions upon those common practices that produce forest devastation. From a conservation standpoint, the Lumber Code's achievement was educational; it made the great body of timber operators aware for the first time of those woods practices requisite to maintain forest lands in a productive condition. The forest industries need, and should have, reasonable public aid toward transforming themselves from transitory industries based on forest exploitation into permanent industries operating on what the forest annually grows and can continue to grow. But the fact must be faced that industrial stabilization resting on stabilized utilization of privately owned forest land is still a long way off.

Stabilized forest-land utilization presupposes stabilized ownership. No private owner will undertake to apply forest management on land which he does not expect either to keep as an investment in timber growing or to sell to some one else as valuable for the same purpose. A great deal of the present industrial forest-land ownership is bound to remain unstable as private property. The farther forest depletion and forest abuse have been carried, the more this holds good. We must face the fact that the prospect of making this land income producing as a permanent timber-growing enterprise is too uncertain and the time when paying returns can be looked for is too remote to make holding and managing it seem good business. Admittedly there is no future for a large part of the industrial forest-land acreage as private property. The pronounced movement toward abandoning it to involuntary public ownership is an impressive indication of this fact. That an extensive policy of public purchase will be adopted as a means of enabling tired carriers of unwanted industrial forest lands to lighten their burden is a prevalent hope among private owners. This

desire to unload is not limited to owners of timberlands that already have been heavily lumbered. An extensive taking back into public ownership of virgin stumpage on lands originally acquired from the public domain under false hopes of its reasonably early marketability is also strongly favored by many private owners.

One of the objectives of public forest policy should plainly be to counteract, through appropriate measures, the forces that are making private ownership unstable. The gravitation of surplus or timber-depleted industrial holdings into the hands of public authorities is, within limits, a corrective process. Private ownership has been overextended and is unable to carry permanently all the load it has optimistically taken on, usually with no intention of carrying it permanently. But the productive timberland of the country affords, and should always afford, a very large field for private enterprise in holding and managing a great part of it. One of the things necessary to promote this is bringing about a due balance between public and private ownership. A well-conceived, large-scale extension of public ownership will reduce the dimensions of the problem created by the past overexpansion of private timber acquisition, and is an essential part of any program for stabilizing ownership, forest use, and the forest industries.

Ever since its inauguration in 1911 the Federal policy of buying lands for national forests has, with insignificant exceptions, been applied to lands having on them very little, if any, merchantable timber. With exceedingly limited purchase funds available in comparison with the great acreage of land urgently needed in public ownership to attain the public ends desired, no other course was practicable. With markedly larger sums available, there has been inaugurated during the past year a definite modification of this former course; a start made toward purchases that permit the practice of forestry immediately as a going enterprise. The thought has been expressed that this is an unsound policy; that to remain noncompetitive with industry Federal purchases of forest lands ought to be limited to land with values so low that no private owner will want it.

This would mean that offers to the Government of timber stands which are suitable either for ruthless exploitation or for a forest-management enterprise should be declined, even though the major likelihood is that a private purchaser will exploit the land instead of putting it under permanent forest management. It is true that reasonable public encouragement of and assistance to private forestry should be offered, but it is equally true that the public course must be governed by what will most advance the public welfare. To wait always until the forest has been so wrecked that only the public purse can possibly meet the expense of reclaiming it, or to limit public forestry to lands too poor to make timber production cover its cost, would mean that the true objective of public-forest policy had been lost sight of. For that policy must place first the need of the people of the United States for efficient land use as a means of gainful employment and stabilized and permanent prosperity. The essential point is that unless public acquisition is stabilized, programmed, and pressed forward on broad lines with all possible speed, the potential capacity of the forests of the country to provide work for a large dependent population and to furnish raw materials for industry and commerce will inevitably diminish instead of being built up.

#### COOPERATION UNDER ARTICLE X OF THE LUMBER CODE

One of the expressed purposes of the National Industrial Recovery Act was to conserve natural resources. The Lumber Code, in furtherance of this objective, contained an obligation on the part of lumbermen to apply such practicable forestry measures in connection with timber cutting as would be necessary to keep their timberlands continuously productive. This obligation was covered by article X (conservation) of the code.

The code was administered by the organized industry, with the national and regional trade associations serving as the code agencies. Lumbermen constituted the administrative committees having the forestry work in charge, and these committees employed technical foresters to supervise the field work.

The public interest involved in the proper management of privately owned forests led the Forest Service to cooperate actively in the code forestry project. The knowledge and experience of our research and administrative personnel throughout the United States were made available to the industry. Assistance was given in the drafting of the general principles to govern the undertaking



and in the formulation of the detailed regional rules of practice to be followed on the ground. Field studies were conducted with the object of strengthening the rules and simplifying their application, and educational and demonstrational work was carried on among the operators.

The code forestry requirements became effective June 1, 1934, and terminated when all codes were abolished on May 27, 1935—a period of about 1 year.

The results obtained under the code in terms of actual improved forestry practices in the woods were apparently not great. The project involved the establishment of a new point of view as well as new methods in dealing with the management of a vast majority of the 30,000 or more operations throughout the United States. Little impression could be made in the short period during which the forestry requirements were in effect.

The chief contributions of article X to forest conservation were educational in character. The code forestry work produced a clearer understanding throughout the industry of the importance and technique of sustained-yield management designed to promote community and industrial stability. It supplied information on the benefits to be derived from selective logging, and gave instructions on the character of the protective and silvicultural measures required to keep a forest continuously productive. The participation by the lumbermen in the active direction of the forestry work was a very important factor in achieving this desirable result in forest education.

### RESETTLEMENT PLANNING ON THE NATIONAL FORESTS

During the year detailed economic and population studies were completed for over 40 possible resettlement projects. The units studied are 100,000 to 500,000 acres in size, including national-forest and adjoining lands, each unit constituting with its lands, industries, villages, farms, educational institutions, etc., a community of economic and social interest.

The objective was to determine the need for and feasibility of resettlement and rehabilitation projects on the national forests. For the areas covered, a need is indicated for: (1) The resettlement of families on submarginal farms and in decadent industrial towns; (2) opportunities for table gardening and part-time farming for seasonal and part-time employees of the Forest Service and of lumbering and other industries in and adjacent to the national forests; (3) employment opportunities for families now barely subsisting on farms too small to yield a full living, or stranded in towns and villages by the exhaustion of private timber resources, the closing down of mines, etc.; and (4) employment opportunities for workers temporarily dependent upon public relief because of the economic depression.

The need for resettlement of families now on submarginal farms includes such considerations as the following: (1) Most of the submarginal farms within the forest units are best suited and needed for national-forest purposes; many owners of such lands will not sell until offered opportunities for resettlement on good land; many others would sell at more reasonable prices if such opportunities were available; (2) occupants of isolated submarginal farms within the forests often cause a serious fire risk; (3) their presence often prevents the best development of recreation and wildlife resources; (4) the cultivation of steep submarginal lands results in erosion and defeats the objectives of watershed protection, for which many of the forests were established.

Three classes of feasibility are encountered: (1) Where reasonably assured employment and good agricultural land are available to make resettlement feasible without further assurance of funds for public works programs or additional employment opportunities; (2) where some assurance is needed that funds will be regularly available for forestry work before resettlement will be feasible; (3) where the resident population exceeds both the reasonably assured employment and the economically justifiable forestry work and hence new opportunities must be created before resettlement will be feasible and a means available for families to free themselves from continued dependence upon public relief.

It is estimated that not over 10 percent of the resettlement needs of the eastern national forests fall in the first class. About 70 percent could be solved if funds were reasonably assured for a continuing program of intensive and extensive forestry. Twenty percent of the problem could only be solved by creating new opportunities. This estimate includes only the submarginal farmers and the stranded workers once primarily dependent upon forest work, and those intermittently employed in and adjacent to national forests.

The problem in the western national forests is less acute, and quite different. It principally requires the control of "cut-out and get-out" lumbering of private forests within and adjacent to the national forests, the development of sustained-yield operations, and the provision of resettlement opportunities for part-time workers now living in transient lumbering camps and logging towns.

On June 30 the reports on the several areas were being reviewed, and those falling in the first feasibility class are to be submitted to the Resettlement Administration as work-relief projects.

These studies reemphasize the problems of overpopulation, lack of economic opportunities, and submarginal farming in the forest regions. They attempt to show the place of forestry in the economic and social reconstruction of the severely depleted cut-over areas of the eastern forest regions. Until timber resources are restored so that sustained-yield logging and lumbering can start, the thinning and care of growing timber and other forest work can give useful employment to a large part of the destitute and stranded population of these regions. Until there is some assurance that funds will be regularly available for such work the bulk of the desirable resettlement on the eastern forests cannot be undertaken; nor can many of the most seriously eroding and other lands needed for forestry be acquired until the assurance of such employment makes it feasible to resettle the families now residing on such lands.

Aside from the long-time program, the needs of the resident workers of the national forests should also be recognized in any temporary program of work relief. Accordingly, plans have been prepared for the 1936 work program which, if approved, will give employment to nearly all of the resident unemployed suitable forest workers in and adjacent to the national forests.

### FOREST-LAND PLANNING, PUBLIC AND PRIVATE LANDS

A study was conducted for the National Resources Board to determine the specific areas which should be under each of the forms of management and ownership recommended in the Copeland report. Cooperating with the National Resources Board, State forestry agencies, planning boards, experiment stations, and other interested agencies, data were assembled and recommendations were prepared for a program of forest ownership and management for over 80 percent of the total forest area of the country. The recommendations were incorporated into a report, the high lights of which appeared in part II of the National Resources Board report. The detailed report is in the hands of the National Resources Committee, which plans to publish it as a part of a detailed report on land resources.

For the area covered by the study more detailed information on forest lands was collected than ever before existed. The plan of ownership and management is, of course, subject to current revision, but it provides for the first time a definite basis of understanding for the several agencies interested in and responsible for public forestry activities and the extension of public forest holdings.

The recommendations for ownership substantially support those of the Copeland report, recommending a total of 178 million acres of additions to public forest ownership. An increase of 9 million acres of forest lands in public ownership or in process of acquisition was shown to have occurred since the preparation of the Copeland report.

### THE GREAT PLAINS SHELTERBELT PROJECT

During the year plans for the Great Plains Shelterbelt Project were definitely inaugurated and the exterior boundaries established. The present boundaries encompass a strip 100 miles wide, extending north from Mitchell, Nolan, Taylor, and Callahan Counties in Texas through Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota to the Canadian boundary. The location of the shelterbelt was decided on only after a careful study of prevailing wind directions, wind velocities, average annual precipitation, position of the water table, and the character of the soil in relation to tree growth. Within this 100-mile belt, shelterbelt strips 10 rods wide will be established 1 mile apart, so located as to intercept the prevailing winds.

The strips will not be laid out in a uniform pattern; nor will all the lands within the belt be provided with them, since in many places the conditions are not suited to tree growth. It is expected that the farmers of the region will supplement the strips with intervening plantings of lesser widths, ultimately



surrounding each 40 acres with some degree of protection. In addition to the belt planting, cooperation is being extended to farmers in the establishment of windbreaks about farm buildings as a protection to human habitations and to stock.

Real progress was made in the spring of 1935 in getting the projects under way. Some work was done in all the States concerned. All together, 125 miles of shelterbelt plantings were established, 4,800 acres of farmstead planting on 1,800 farms were completed, and 552 acres of land were placed under lease for nursery purposes and seeded to the needed species. Barring extreme weather conditions, unforeseen insect infestations, or fungi infections, it is expected that about 56,000,000 seedlings will be available for next spring's planting.

## THE CIVILIAN CONSERVATION CORPS

The objective of the Civilian Conservation Corps, organized under the provisions of the Emergency Conservation Work Act of March 31, 1933, has been to engage unemployed young men upon noncompetitive but constructive work in the conservation, restoration, and development of natural resources. This objective has been attained in signal degree. The man power of this veritable army has been made available to serve the needs of the several Federal agencies charged with conservation functions, and particularly the Forest Service.

The national forests, located in 37 States and in Alaska and Puerto Rico, have continuously afforded a vast work reservoir, absorbing nearly a third of the corps' average man power of 300,000 enrollees. In addition to work on these national properties, and in order to further cooperative measures authorized by Congress, the Forest Service has supervised work projects on State and private forest lands, and has operated camps assigned to the Tennessee Valley Authority. Over 70 percent of the project work of the corps has, during the most of the fiscal year, been under the planning and supervision of the Forest Service. At the close of the year, after the erosion-control camps were turned over to the Soil Conservation Service, the labor strength of 946 camps of 200 men each out of the total of 1,641 Civilian Conservation Corps camps was still under the direction of the Forest Service.

The work accomplished by the Civilian Conservation Corps (reported in detail by the Director of Emergency Conservation Work for the initial 2-year period ended Mar. 31, 1935) has been monumental. For the Forest Service as a whole this work represented the labor of 38,605,470 man-days. The projects constructed are evaluated at \$343,703,402. This work, of varied character, included principally forest-fire prevention and control through the construction of telephone lines, look-out towers, airplane landing fields, tool houses and boxes, and foot, horse, and motor-truck trails; the destruction of forest-destroying insects and fungi; improvement of the commercial value of forests by thinnings and the removal of dead, defective, and weed trees; mapping of forest types and estimates of their value; reforestation of denuded areas, including the collection of seed, establishment of nurseries, and the planting of seedlings; the construction of public camp grounds and other recreation facilities; revegetation of overgrazed lands, the elimination of rodents destructive to forage cover, the eradication of plants harmful to livestock, and the construction of wells, fences, and corrals; and the development of streams, springs, reservoirs, and ponds for fish, birds, and other wildlife.

Throughout the Civilian Conservation Corps camps an educational program of wide range is directed by the War Department, which has charge of camp administration, in cooperation with the Office of Education of the Department of the Interior. In this program special emphasis is placed upon vocational training. Many young men are particularly interested in opportunities for employment in woods work and allied conservation activities. To this end the Forest Service personnel in the camps has actively assisted the educational advisers in the work of instruction. This instruction consists of simple orientation courses to give the enrollee an appreciation of the place of forestry and conservation in the national economy; to promote the value of his citizenship; to stimulate intelligent interest in his particular Civilian Conservation Corps work project; and to guide his selection of future employment. Training in particular skills and techniques is emphasized to promote the enrollee's job efficiency, to qualify him for advancement, and to prepare him for a job as a skilled worker upon completion of his term of service with the corps.

The Civilian Conservation Corps has proved to be a singularly successful enterprise in the rehabilitation of young men and the development of natural

resources. The work accomplished for the national forests alone has greatly advanced the normal program of construction projects. The provision of Congress authorizing the extension of the operation of the corps under the Works Relief Act of April 8, 1935, and the increase of its strength to 600,000 men will nearly double the number of work projects during the current fiscal year. Provision has been made to establish a total of 2,916 camps, and the work projects of more than half of them will be under the direction of the Forest Service. Under the expanded program about 50 percent of the labor strength of these camps will be allocated to the national forests and 25 percent to State forests; the remainder will be largely allocated to private forest lands.

### DEVELOPMENTS IN ORGANIZATION

The great expansion in the whole scope of national-forest work of the past 2 years has made obsolete old concepts of the functions, duties, and responsibilities of forest officers, from district rangers up to the Chief of the Forest Service. In cooperation with the Department of Agriculture, the Forest Service, early in 1935, undertook a comprehensive restudy of the entire organization structure. The duties and responsibilities of all Forest Service positions were scrutinized and redefined, and a reclassification of many field positions followed. In the Washington office the results of the organization studies have not yet been fully applied.

Early in 1935 a new plan of regular staff conferences was begun. The regional foresters, directors of the forest experiment stations, and members of the central staff meet quarterly (except in the summer) to consider questions of policy and strategy. The staff meetings are proving an important means of meeting current policy problems, keeping all units of the Forest Service in close touch with each other, and bringing to bear on the difficult questions of today the ability and range of viewpoint of the whole Forest Service.

A further new development in staff work has been the inauguration of special committees, made up of Washington staff members and regional and experiment station officers. One of these committees is now engaged in a comprehensive study of the personnel problem of the Forest Service, including recruiting, methods of development through in-Service training and change of assignment, and the selection and development of men for higher leadership. It is clear that far greater attention to and formalization of personnel management, including a recognized budgetary set-up, is required than heretofore. A step in this direction has already been made in the field reorganization and reclassification through the creation of a division of personnel management in several of the regional offices.

One of the more significant conclusions from the personnel committee's study is the urgent need for a wider grounding of forest executives and leaders in economics, the social sciences, and other comparable fields. The reclassification of field positions was essentially to meet the need for Forest Service participation in land planning, attack on the whole relief problem, and other economic and social measures not always recognized as being involved in technical forestry.

### LEGISLATION OF THE YEAR

The legislative record which follows includes, for convenience, all acts passed at the first session of the Seventy-fourth Congress, whether before or after the close of the fiscal year.

The acts making appropriations were:

The act of April 8, 1935 (Public Resolution 11, 74th Cong.), appropriating \$4,880,000,000 for relief purposes. From this appropriation \$12,000,000 was made available prior to the date of this report for the acquisition of lands under the Weeks law; \$15,000,000 for the protection, improvement, and extension of the national forests and for research, including \$1,991,000 for the shelterbelt project; and \$750,000,000 for the Emergency Conservation Work and associated activities.

The Agricultural Appropriation Act, fiscal year 1936 (Public, 62, 74th Cong.), approved May 17, 1935.

The following acts relating to national-forest administration were passed:

The act of April 17, 1935 (Public, 38, 74th Cong.), authorizing the Secretary of Agriculture to cancel timber-sale contracts entered into prior to June 30, 1934.

The act of March 2, 1935 (Public, 16, 74th Cong.), authorizing conveyance to the State of Mississippi for the use of its National Guard certain lands acquired for forestry purposes.



The act of August 26, 1935 (Public, 337, 74th Cong.), authorizing the appropriation of receipts from the Wasatch and Uinta National Forests, Utah, for acquiring privately owned lands in those forests.

The act of August 29, 1935 (Public, 395, 74th Cong.), authorizing the Federal Government to cooperate with the States in promoting the development of State forests. This is the so-called "Pulmer Act."

The act of May 29, 1935 (Public, 82, 74th Cong.), authorizing the disposal of abandoned improvements at Civilian Conservation Camps.

The act of June 25, 1935 (Public, 164, 74th Cong.), authorizing the acquisition by exchange of certain privately owned lands within the Lincoln National Forest, N. Mex., but reserving minerals therein to the State.

The act of August 27, 1935 (Public, 358, 74th Cong.), setting aside certain lands within the Prescott National Forest, Ariz., for recreational uses by the city of Phoenix, Ariz., under cooperative agreement with the Forest Service.

The act of June 20, 1935 (Public, 156, 74th Cong.), transferring certain lands from the Cibola National Forest to the Zuni Indian Reservation, N. Mex.

The following acts authorized additions to national forests:

The act of August 2, 1935 (Public, 227, 74th Cong.), authorizing the extension of the boundaries of the Chelan National Forest, Wash., for a distance of 4 miles from the present boundaries.

The act of June 13, 1935 (Public, 130, 74th Cong.), authorized the addition of certain lands to the Willamette National Forest, Oreg.

The act of June 13, 1935 (Public, 131, 74th Cong.), authorized the addition of certain lands to the Siskiyou National Forest, Oreg.

The act of May 24, 1935 (Public, 68, 74th Cong.), authorized the addition of certain lands to the Deschutes National Forest, Oreg.

The act of August 20, 1935 (Public, 288, 74th Cong.), added lands to the Medicine Bow National Forest, Wyo.

The act of August 26, 1935 (Public, 328, 74th Cong.), added certain lands to the Pisgah National Forest, N. C.

### PROGRESS IN STATE FORESTRY LEGISLATION

Laws authorizing Federal land acquisition for national forests were passed by Maine, Rhode Island, Ohio, Indiana, Idaho, Montana, Utah, California, Oregon, and Washington, while New Hampshire, Missouri, and Arkansas extended the scope of earlier authorizations. In all, 34 States have now authorized such acquisitions, in some cases with various forms of limitations, in others without specified restrictions. Maine restricted the acquisition to certain counties, by purchase only, and made inapplicable to lands acquired under the new law the provisions of the enabling act mentioned a year ago in this report. The Idaho, Montana, and Utah laws likewise specified acquisition by purchase; Montana, however, also authorized boards of county commissioners to exchange delinquent tax lands for Government lands or standing timber of equal value. Oregon stipulated that all contemplated acquisitions must have the approval of a State board of forest conservation, created by the act and comprising the Governor, the State forester, the chairman of the State tax commission, and two appointees of the Governor chosen from the county judges in counties containing at least 400,000 acres of forest land; and also required a county-court order of approval prior to acquisition in any county. Washington authorized acquisition by either purchase or gift, but only with the approval of the State forest board, and retained a concurrent jurisdiction to tax persons and corporations and their property and transactions on the land acquired.

New Hampshire granted consent to the acquisition of lands better adapted by reason of quality, location, or condition to public conservation, forestry, recreation, or experimental or demonstrational purposes than to continued private ownership and development, if recommended by the land-use board and approved by the Governor and council. The board was established by the act, to consist of five members appointed by the Governor with the advice and consent of the council. Arkansas removed the limitation which had confined acquisition to counties wherein national forests are located, or adjoining counties, and Missouri removed the restriction prohibiting acquisition of more than 100,000 acres in any county. In addition Arkansas provided for the sale to the Federal Government of tax-forfeited lands within the boundaries of national forests.

An Idaho constitutional amendment giving the legislature power to authorize negotiation by the State Board of Land Commissioners of land-exchange agreements with the United States will be submitted to the electors at the general election in 1936. An amendment to the Minnesota constitution authorizing exchanges will be submitted to the electors at the general election in 1936. A similar amendment, mentioned in this report 2 years ago, was lost at the November 1934 general election.

Washington authorized the State forest board to issue utility bonds up to \$300,000 for purchasing private lands found through land classification to be

suitable only for growing timber, provided the purchase can be made at a satisfactory price and will enable the State to build up sizeable blocks of timbered areas. New York by concurrent resolution approved the Federal program of purchasing marginal and submarginal farm lands for reforestation and other conservation purposes. Arkansas authorized the State forestry commission, with the approval of the Governor, to set apart for permanent State forests certain suitable State-owned lands, and also lands which have reverted to the State for taxes; and provided for the exchange of lands to block up areas into suitable units.

North Carolina provided for State management of federally acquired submarginal lands suitable for creating and maintaining State-controlled forests and other recreational areas; and also for holding vacant and unappropriated State lands which are suitable for national or State forests or parks. Another act protects from injury land under option by the Federal Government. Minnesota created 13 new State forests, authorized the acquisition of lands within them by gift, purchase, or condemnation, made additions to 3 existing State forests, and authorized the director of the division of forestry to purchase sites not exceeding 40 acres in area for administration and other forestry purposes; the old law limited the area to 5 acres. California authorized the director of natural resources to receive, hold, and acquire land for future development for forestry purposes and to manage these lands and dispose of the products therefrom.

County zoning, which provides for setting aside areas for purposes of trade, residence, recreation, farming, forestry, and conservation of soil and water supply, was adopted in Tennessee and Michigan. In the latter State, county boards of supervisors were given the power to regulate zoning; State, county, and regional commissions are to prepare county zone maps.

In anticipation of the enactment of a law for Federal acquisition of forest land for administration by the States as State forests, Alabama, Delaware, Florida, Iowa, Louisiana, Maryland, Michigan, Minnesota, New Jersey, North Carolina, North Dakota, Rhode Island, South Carolina, and Texas passed enabling acts authorizing their respective State forestry agencies to enter into cooperative agreements with the Secretary of Agriculture for the acquisition and development of State forests. Some States were already equipped with legislation to qualify for Federal assistance under the act. New York by a concurrent resolution approved Federal land purchases for State forests. Vermont gave consent to the acquisition by the United States, by purchase or gift, of certain lands necessary for the establishment, consolidation, and extension of State forests and other reservations, subject to several strict provisions in favor of the State.

Connecticut provided that any receipts resulting from management of the State forests, including the proceeds of sales of wood, timber, and other products, shall go into a forestry fund, to be expended in the protection, management, and development of the forests, the preparation and marketing of forest products therefrom, and land acquisition for their extension and completion. Michigan authorized the director of conservation to dispose of timber from State lands.

Oregon increased the membership of the State board of forestry from 7 to 8, the new member to be appointed by the Governor on the recommendation of the Western Pine Association. New Hampshire changed the name of the forestry commission to forestry and recreation commission. Vermont created a department of conservation and development, to be administered by a State board of the same name, and to comprise a forest service, a fish and game service, and a publicity service. The State forest service was formerly under the department of agriculture. Iowa abolished the State board of conservation, the State fish and game commission, and the office of State forestry commissioner, and created a new agency to be known as the "State conservation commission", made up of 7 citizens of the State; the administrative head to be called "State conservation director."

Much State forest-fire legislation was revised. Oregon lengthened the closed season 15 days, making it from May 15 through October 15, and changed the requirements relating to snag felling in conjunction with timber operations in the fir belt so as to exclude Jackson and Josephine Counties and make the requirements identical with those fixed by the Lumber Code. Tracts may be examined and, if the number of snags is excessive, relief can be given. However, the operator may be required to fell a certain number of snags, and the State forester may designate the area. Another Oregon law gives the county courts authority to adjust the valuation on timberlands damaged by a fire



covering more than 10,000 acres. California authorized the division of forestry, in cooperation with the State Water Commission, to determine experimentally the effect of burning off brush and debris on run-off and water level.

Florida gave the State Board of Forestry and the Federal Government liens prior to all accruing thereafter on cooperators' lands when the fire-control assessment is not paid; authorized a referendum to determine whether or not organized fire-prevention and control work in cooperation with the State Board of Forestry shall be carried on by the counties; authorized the board of forestry to set up forest-protection districts within which permits will be required before any burning is allowed; provided penalties for allowing fires to spread to adjoining lands; and authorized the board to offer rewards for the apprehension of violators. Michigan authorized the Governor to prohibit, in time of drought or extreme fire danger, the use of fire or tobacco in the forest, and required slash disposal within a minimum of 50 feet from highway rights-of-way. West Virginia changed the rate of compensation for fighting forest fires, formerly restricted to not more than \$1 per day, to a rate per hour to be determined from time to time for each county by the director of conservation; payment to be a charge against the State instead of the county. North Carolina provided for protecting its forested area from fire with payment of one-half the cost by the county, to an amount not to exceed in any 1 year 5 mills per acre of total woodland area in the county, unless more is specifically authorized by the county commissioners to meet an emergency.

Idaho, Indiana, New Hampshire, North Carolina, North Dakota, Vermont, and Washington enacted laws making provision for reimbursement of the Federal Government for the expense of emergency conservation work if and when, by a sale of land or products, the State derives a profit from the work. Oregon passed similar legislation, and in addition provided for an appropriation of \$20,000 for the work during the next biennium. New Hampshire continued the unexpended balance of the fiscal year 1934-35 appropriation for emergency unemployment relief by forestry and general improvement work. Rhode Island provided \$10,000 for renting, leasing, or purchasing property needed in connection with the work of the Civilian Conservation Corps or to establish and maintain forest areas for such work; and Iowa appropriated \$500,000 for cooperation to further the Federal emergency conservation program, primarily through the purchase of State forests and State park lands.

South Dakota authorized entering into agreement with the United States for the improvement of State lands by the establishment and maintenance thereon of shelterbelts of trees and other plants, and North Dakota by a concurrent resolution endorsed the Federal shelterbelt project.

Oregon provided machinery for collecting currently taxes on timber removed from tax-delinquent property, to prevent the removal of the timber between March 1 of each year and the tax-payment date of the subsequent year without paying the taxes, and then letting the land revert. The State reforestation lands law was amended, principally by the elimination of the yield tax on forage; also, the annual forest fee was lowered for eastern Oregon to 4 cents per acre in place of the former State-wide 5-cent fee. Another Oregon law authorizes the State Tax Commission to correct, as of the year of the original assessment, the "erroneous assessment" on any property the amount of which is in excess either of its true value or of the prevailing ratio to true value at which other property is assessed, and if approved by the county board of equalization concerned, all taxes on property so reassessed are reduced accordingly. Wisconsin transferred the State treasurer's duties in connection with the forest crop law to the conservation commission; and enacted a law permitting the owners of farm wood lots suitably protected against grazing, or of farm lands with a gradient of 30 percent or more which the owner will make a reasonable attempt to protect from erosion by reforesting it, to obtain complete exemption of both land and timber values by applying for and obtaining classification. Michigan and Alabama liberalized their forest-tax laws in certain minor features.

Pennsylvania practically reenacted the two 1913 auxiliary forest reserve and tax acts which were declared unconstitutional in 1931, with some omissions and additions designed to conform to the points raised by the court. Revival of all contracts entered into with forest owners under the old law was authorized.

Massachusetts placed the duty of enforcing fish and game laws within State forests on the forester, the State fire warden, and members of the State police. Florida made natural resources a required subject in State educational insti-

tutions and high schools; established a department of forestry in the University of Florida; and authorized the State Board of Forestry to establish a park service, to cooperate with State and Federal agencies in acquiring, developing, and administering State parks, and to cooperate with counties in park work. Minnesota provided for licensing Christmas-tree dealers and tagging Christmas trees sold within the State, and Idaho for licensing nurserymen, with a schedule of license fees.

### WORK OF THE YEAR IN STATE COOPERATION

Federal appropriations for cooperative work with the States during the year, as compared with those in 1934 and 1933, are shown in table 1.

TABLE 1.—*Appropriations for State cooperation, 1934-36*

Item	Amount appropriated for fiscal year—		
	1934	1935	1936
For the prevention and suppression of forest fires, and for the forest-taxation inquiry and the insurance study (secs. 1-3 of the Clarke-McNary law).....	\$1,565,635	\$1,573,619	\$1,578,632
For the distribution of forest planting stock to farmers (sec. 4 of the same law).....	56,053	56,296	56,379
For farm-forestry extension (sec. 5 of the law, administered by the Division of Cooperative Extension).....	50,240	51,354	56,838

<sup>1</sup> The item of the appropriation act was \$1,587,513. The initial administrative cut was \$393,878, of which \$375,000 was later restored.

<sup>2</sup> Made up as follows: \$1,348,619 from the Agricultural Appropriation Act of Mar. 25, 1934, and \$225,000 from the Deficiency Appropriation Act of June 19, 1934.

<sup>3</sup> The item of the appropriation act was \$74,733. The administrative cut was \$18,683.

<sup>4</sup> The item of the appropriation act was \$84,787. The administrative cut was \$14,547.

Table 2 shows in detail Federal, State, and private funds disbursed by the States or expended under their supervision for the prevention and suppression of forest fires, and the Federal and State funds disbursed by the States for the production and distribution of trees for "windbreaks, shelterbelts, and farm woodlots."

TABLE 2.—*Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1935*

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Alabama.....	\$35,000.00	\$13,467.25	\$24,398.83	\$72,775.63	\$673.04	\$931.49	\$1,604.53
Arkansas.....	38,720.00	9,470.03	36,496.49	84,686.55			
California.....	160,100.00	202,464.85	239,976.88	602,541.73			
Colorado.....					1,180.00	3,398.57	4,578.57
Connecticut.....	13,750.00	75,193.36	1,815.80	90,762.16	533.82	583.83	1,117.65
Delaware.....	1,400.00	5,799.38	7,109.38	1,300.00	1,300.00	1,341.29	2,641.29
Florida.....	69,090.00	17,240.20	52,037.59	138,277.79	1,610.00	4,146.82	5,756.82
Georgia.....	62,000.00	15,514.20	78,887.15	156,381.35	1,500.00	1,557.95	3,057.95
Hawaii.....	640.00	2,907.99		3,547.99	1,151.75	1,151.75	2,303.50
Idaho.....	65,900.00	52,165.89	170,536.53	288,602.42	1,270.00	2,030.75	3,300.75
Indiana.....	6,246.83	6,246.84		12,493.67	1,630.00	2,921.48	4,551.48
Iowa.....					1,500.00	1,524.35	3,024.35
Kansas.....					854.87	1,333.13	2,188.00
Kentucky.....	4,825.14	5,577.81		10,402.95	1,000.00	2,899.11	3,899.11
Louisiana.....	41,700.00	51,669.35	21,831.05	115,250.40	1,500.00	1,500.00	3,000.00
Maine.....	48,900.00	186,637.75		235,537.75	433.56	433.54	867.10
Maryland.....	11,300.00	40,388.48	251.04	51,937.52	954.00	5,464.45	6,418.45
Massachusetts.....	27,500.00	67,973.92		95,473.92	1,740.00	5,833.49	7,573.49
Michigan.....	105,700.00	422,024.81		527,724.81	1,650.00	6,363.91	8,013.91
Mississippi.....	21,345.00	15,188.30	7,557.59	44,090.89	500.00	633.19	1,133.19
Minnesota.....	91,900.00	374,245.14		466,145.14			



TABLE 2.—Cooperative expenditures for fire protection and for the distribution of forest-planting stock under the Clarke-McNary Act, fiscal year 1935—Con.

State	For fire protection				For the distribution of forest-planting stock		
	Federal	State	Private agencies	Total	Federal	State	Total
Montana.....	\$30,050.00	\$14,880.39	\$56,975.61	\$101,906.00	\$1,500.00	\$2,720.48	\$4,220.48
Nebraska.....	.....	.....	.....	.....	1,850.00	9,758.47	11,608.47
Nevada.....	1,490.00	211.00	5,393.44	7,094.44	.....	.....	.....
New Hampshire.....	15,400.00	40,437.94	4,855.74	60,693.68	1,700.00	3,438.51	5,138.51
New Jersey.....	29,400.00	96,444.99	.....	125,844.99	1,820.00	10,953.52	12,773.52
New Mexico.....	2,290.00	2,762.00	2,560.00	7,522.00	.....	.....	.....
New York.....	71,800.00	258,458.08	.....	330,258.08	1,880.00	10,274.91	12,154.91
North Carolina.....	48,922.46	40,818.07	8,104.40	97,844.93	1,160.18	1,160.21	2,320.39
North Dakota.....	.....	.....	.....	.....	1,750.00	7,758.23	9,508.23
Ohio.....	5,200.00	9,586.90	.....	14,786.90	1,810.00	9,014.15	10,824.15
Oklahoma.....	11,767.64	7,593.94	4,173.72	23,535.30	1,500.00	2,656.59	4,156.59
Oregon.....	94,200.00	77,433.25	235,975.55	407,608.80	1,500.00	2,072.95	3,572.95
Pennsylvania.....	22,562.00	246,817.48	.....	269,379.48	1,760.00	5,081.94	6,841.94
Puerto Rico.....	.....	.....	.....	.....	1,690.00	5,618.28	7,308.28
Rhode Island.....	2,000.00	15,391.65	.....	17,391.65	.....	.....	.....
South Carolina.....	30,240.00	10,459.81	30,495.32	71,195.13	1,590.00	3,038.00	4,628.00
South Dakota.....	750.00	1,977.67	.....	2,727.67	1,100.00	1,826.78	2,926.78
Tennessee.....	16,876.81	15,832.27	1,044.54	33,753.62	1,500.00	1,857.56	3,357.56
Texas.....	36,200.00	57,329.33	8,043.85	101,573.21	.....	.....	.....
Utah.....	.....	.....	.....	.....	1,000.00	1,392.64	2,392.64
Vermont.....	5,500.00	7,196.12	2,963.94	15,660.06	1,500.00	10,074.53	11,574.53
Virginia.....	31,766.00	34,443.29	2,102.94	68,306.23	1,283.76	1,283.75	2,567.51
Washington.....	93,100.00	98,271.99	168,465.28	359,837.27	1,473.00	2,759.82	4,262.82
West Virginia.....	30,500.00	37,629.20	30,624.29	98,753.49	1,500.00	7,325.41	8,825.41
Wisconsin.....	71,300.00	297,502.57	.....	368,802.57	1,500.00	4,382.81	5,882.81
Wyoming.....	.....	.....	.....	.....	1,011.71	2,218.00	3,229.71
Administration and inspection.....	76,343.58	.....	.....	76,343.58	791.64	.....	791.64
Total.....	1,533,489.46	2,935,564.52	1,195,507.15	5,664,561.13	55,201.33	150,746.64	205,947.97
Forest taxation and insurance study.....	34,990.03	.....	.....	.....	.....	.....	.....
Unexpended balance.....	5,229.51	.....	.....	.....	1,094.67	.....	.....
Total appropriation.....	1,573,619.00	.....	.....	.....	56,296.00	.....	.....

## COOPERATIVE PROTECTION OF STATE AND PRIVATE FOREST LANDS FROM FIRE

During the calendar year 1934 the total acreage of State and private forest or potential forest land under some form of organized protection from fire was approximately 237,000,000 acres. This is 56 percent of the total of those lands (427,000 000 acres) classed as needing protection. The area protected in 1933 was 221,000,000 acres. Of this increase of 16,000,000 acres, over 12,000,000 acres was in the South. The Rocky Mountain States showed an increase of over three and one-half million acres, due in large part to a redetermination of the areas in need of protection in Wyoming and Colorado. The areas in the States of the South which account for the largest part of this total are as follows:

Virginia, 693,000 acres; West Virginia, 1,154,000 acres; North Carolina, 3,965,000 acres; South Carolina, 851,000 acres; Georgia, 2,770,000 acres; Alabama, 264,000 acres; Louisiana, 145,000 acres; Mississippi, 691,000 acres; Arkansas, 1,913,000 acres.

The three Lake States showed substantial increases as follows: Michigan, 688,000 acres; Wisconsin, 949,000 acres; Minnesota, 59,000 acres. In only four regions was there a net decrease. This in each case was too small to be significant.

Table 2 shows a total of \$4,131,072 of State and private funds spent in cooperative forest-fire protection in the fiscal year 1935. The corresponding totals for the fiscal years 1932, 1933, and 1934 were \$4,370,274, \$3,141,445, and \$3,794,722. Thirty-nine States cooperated, the same number as in the previous fiscal year. Private expenditures for protection which are provided independently of the organized protective system do not appear in table 2. Their amount is not accurately known, although undoubtedly substantial in the aggregate.

The total area of protected State and private land reported as burned over in the calendar year 1934 was 3,514,570 acres (of which 858,530 acres are classed as not having productive value), as against 3,342,690 acres in 1933, and of unprotected forest lands, 37,647,820 acres, as against 40,166,900 acres in 1933. The 2,656,040 acres of protected productive forest land reported as burned over comprised 1.12 percent of the forest area protected. The corresponding percentage for the unprotected area was 20. Of the State and private land burned over in 1934, 91 percent was outside of protected units. The number of fires reported on protected units was 61,254, as against 48,770 in 1933. Of the 1934 number, 27.7 percent were reported as incendiary, as against 22.7 percent in 1933.

During the fiscal year 1935 the development of forest-fire improvements on State and private lands actively continued. The result is marked intensification of the protective effort within protected units. There has been substantial extension of protection to additional areas, and it is believed that with the enlargement of the Civilian Conservation Corps and the increased funds which many of the States have provided for the 1936 forest-fire cooperation work there may be an even larger increase in the areas protected during the present year.

The extent of the improvements contributed by the Civilian Conservation Corps is indicated by such items as the following, which represent the total up to and including March 31, 1935: 15,926 miles of telephone lines, 28,698 miles of firebreaks, 29,783 miles of roads and trails, 575 new look-out towers, 169 look-out houses, and many other improvements; the reduction of fire hazards on 744,204 acres, and a large amount of roadside and trail cleaning.

The foregoing continuous and permanent contribution to the cooperative protection enterprise is of great significance. The future will tell how effectively these improvements will be maintained by the States. The action of many of the Southern States particularly, in providing increased funds for this specific purpose, is highly encouraging.

#### COOPERATION WITH STATES IN TREE PLANTING

In the calendar year 1934, 20,208,106 trees distributed by States cooperating under section 4 of the Clarke-McNary law were planted in windbreaks, shelterbelts, and farm wood lots by private landowners. This was 8 percent less than in 1933. During the fiscal year a cooperative agreement providing for a new project was executed with Arkansas. This brings the total number of States cooperating to 40, in addition to Puerto Rico and Hawaii. An agreement is in process of execution with still another State, Texas.

The small Federal assistance continues to prove its importance as a stabilizing force. The maximum again set up for any one State was \$1,500. Unless the appropriation can be somewhat increased it will be necessary to reduce the maximum to a quite inadequate sum. Approximately 20,000 acres were added to forest plantations on farms during the fiscal year 1935 as a result of these cooperative projects. The leading States in the number of trees distributed were New York, Pennsylvania, Puerto Rico, Indiana, Wisconsin, Ohio, and Nebraska, each of which distributed more than a million trees for planting on farms.

#### COOPERATION WITH STATES IN FARM-FORESTRY EXTENSION

The management of farm woodlands to increase their returns and the planting of trees on farms for timber production or shelterbelts are the leading projects in the extension forestry programs of the States. These programs are conducted with the aid of Federal cooperation under section 5 of the Clarke-McNary law, administered by the Extension Service of the Department of Agriculture with the cooperation of the Forest Service. Under this cooperation 33 States and 1 Territory are employing 38 extension foresters and receiving the cooperative aid of 2 Federal extension specialists.

The various forestry-extension activities during the calendar year 1934 included thinning or "weeding" forest stands on 5,237 farms, selection cutting of trees on 9,681, improved practices of producing maple sugar and sirup on 1,798 and of producing naval stores on 2,914, and cooperation in the prevention of forest fires on 57,749. On 8,929 farms a total of 40,560 acres of land was reforested by planting small trees for timber production. Windbreaks or



shelterbelts were established by 8,557 farmers, while 5,229 farmers planted trees to check soil erosion. More than 1,100 farmers followed recommendations for timber estimating and appraisal, 2,895 for marketing forest products, and 7,027 for preservative treatment of farm timbers. All together, 22,715 farmers planted trees for different purposes on their farms.

Boys and girls to the number of 13,429 were enrolled in 4-H forestry clubs, and 10,340 of these completed projects in growing trees in nursery beds, planting land with trees, thinning, weeding, or pruning forest trees, and protecting 38,544 acres of farm timberland from fire.

#### NATIONAL-FOREST ADMINISTRATION

The expenditures for national-forest administration, protection, improvement, reforestation, and extension, totaling \$75,933,994.83, are shown in detail on page 53.

The Federal funds made available for the national-forest enterprise in the fiscal years 1934, 1935, and 1936 are shown in table 3.

TABLE 3.—*Direct appropriations<sup>1</sup> and supplementary allotments of Federal funds for the national-forest enterprise, 1934-36*

	1934 <sup>2</sup>	1935 <sup>3</sup>	1936 <sup>4</sup>
General expenses of administration, protection, and improvement.....	\$6, 047, 321	\$6, 684, 459	\$7, 745, 984
Specifically for:			
Fire control.....	524, 450	2, 460, 487	112, 561
Improvements, tree planting, etc.....	15, 350, 397	382, 206	9, 833, 924
Land acquisition.....	18, 965, 000	11, 535, 000	14, 832, 150
Forest development, roads, and trails (construction and maintenance).....	10, 350, 000	3, 000, 000	3, 328, 000
Forest highways (construction and maintenance).....	19, 057, 400	8, 500, 000	4, 082, 600
Total.....	70, 294, 568	32, 562, 152	39, 935, 219

<sup>1</sup> Less administrative reductions imposed by the Bureau of the Budget

<sup>2</sup> Of the amounts shown for 1934, \$58,047,745 was derived from allotments of National Industrial Recovery Administration funds, available for expenditure until June 15, 1935.

<sup>3</sup> The fourth entry in this column represents an allotment of \$11,035,000 from National Industrial Recovery Administration funds, available for expenditure until June 15, 1935, and an allotment of \$500,000 from the emergency relief appropriation, available until June 30, 1937.

<sup>4</sup> The fourth entry in this column represents allotments from the emergency relief appropriation, available until June 30, 1937.

The last two entries in the 1934 column of table 3 are not in full accord with the showing made in last year's report because of changes in the allotments which increased the forest-development road funds by \$100,000 and decreased the forest highway funds by \$400,000. The second entry in the 1935 column is greater by \$2,348,000 than the corresponding entry in last year's report, which showed merely the nominal amount appropriated in advance for fire-fighting expenditures. As usual, this was supplemented later by a deficiency appropriation to replenish other funds temporarily drawn upon for fire fighting, thus bringing the total to the amount shown above.

#### THE NATIONAL-FOREST PROPERTIES

The gross area of the national forests on June 30, 1935, was 188,292,217 acres, of which 24,982,215 acres were in ownership other than that of the United States; leaving the net area 163,310,002 acres. During the year the gross area of the national forests, as fixed by Presidential proclamations or Executive orders or by acts of Congress, increased by 255,194 acres; the net area, by 718,878 acres. If to this be added 1,860,117 acres acquired under the Weeks law but not yet covered by proclamation or Executive order, the total net national-forest area is raised to 165,170,119 acres.

Table 4 shows the additions and eliminations.

TABLE 4.—National-forest additions and eliminations, fiscal year 1935

National forest	State	Additions	Eliminations	National forest	State	Additions	Eliminations
		<i>Acres</i>	<i>Acres</i>			<i>Acres</i>	<i>Acres</i>
Absaroka.....	Montana.....	1 80		Harney.....	South Dakota.....		2 10,175
Arapaho.....	Colorado.....	1 160		Kootenai.....	Montana.....	1 3,758	
Do.....	do.....	1 320		Lolo.....	do.....	1 640	
Blackfeet.....	Montana.....	1 7,790		Do.....	do.....	1 61	
Do.....	do.....		2 9,635	Do.....	do.....	1 1,588	
Do.....	do.....	1 160		Oehoco.....	Oregon.....	1 80	
Black Hills.....	South Dakota.....	2 1,556		Rogue River.....	do.....	1 240	
Do.....	do.....	1 160		Shasta.....	California.....	1 160	
Do.....	Wyoming.....	1 320		Siskiyou.....	Oregon.....	3 59,593	
Do.....	do.....	1 120		St. Joe.....	Idaho.....	4 83,042	
Do.....	South Dakota.....	1 80		Tongass.....	Alaska.....	2 544	
Chippewa.....	Minnesota.....		3 168	Do.....	do.....		2 16
Chugach.....	Alaska.....		2 4	Do.....	do.....		2 40
Do.....	do.....		2 14	Do.....	do.....		2 1
Cibola.....	New Mexico.....		2 2	Do.....	do.....		2 292
Do.....	do.....		3 11,931	Do.....	do.....		2 38
Clearwater.....	Idaho.....	4 7,321		Tusayan.....	Arizona.....		2 5,760
Deschutes.....	Oregon.....	1 160		Uinta.....	Utah.....	2 17,741	
Do.....	do.....	1 31,244		Wasatch.....	do.....	2 57,501	
Do.....	do.....	1 32,891		Wenatchee.....	Washington.....	1 480	
Flathead.....	Montana.....	1 743		Whitman.....	Oregon.....	1 2,401	
Gunnison.....	Colorado.....	1 240					
Harney.....	South Dakota.....	1 2,425		Total.....		313,599	38,076

<sup>1</sup> Private lands acquired through exchange.<sup>2</sup> Made by Presidential proclamation or Executive order.<sup>3</sup> Made under acts of Congress.<sup>4</sup> Made by donation of private lands.<sup>5</sup> By purchase for administrative use.

The gross area changes in detail were: 701 acres added by purchase for administrative purposes, 90,603 acres by donation, 77,342 acres by Executive order, 85,360 acres through acquisition by exchange of lands outside of national-forest boundaries, and 59,593 acres by an act of Congress; while 25,977 acres were eliminated by Executive order and 12,099 acres by acts of Congress, and area recomputations based on better data deducted 20,339 acres.

The act of Congress added to the Siskiyou National Forest in Oregon highly productive timberland, to pass ultimately to Federal ownership through donation by the present owners. The additions by Executive orders were of 1,556 acres to the Black Hills National Forest in South Dakota, 17,741 acres to the Uinta National Forest in Utah, and 57,501 acres to the Wasatch National Forest in Idaho, 83,042 acres on the St. Joe Forest in Idaho, and a small area on the Gunnison in Colorado. The most important additions through exchange were two, aggregating 64,135 acres on the Deschutes in Oregon, and lesser ones on the Blackfeet, Kootenai, and Lolo in Montana, and the Whitman in Oregon. The remaining acquisitions through exchange were in numerous widely scattered small holdings.

The principal eliminations by Executive orders were of approximately 9,635 acres from the Blackfeet Forest in Montana; 10,175 acres from the Harney National Forest in South Dakota; 5,760 acres from the Tusayan National Forest in Arizona; and 387 acres from the Tongass National Forest in Alaska, the latter to permit of entries under the Trade and Manufacturing Act for lands occupied and developed under special-use permit. From the Cibola National Forest in New Mexico 11,931 acres were eliminated by an act of Congress which added them to the Navajo Indian Reservation. The other changes were of minor character and involved numerous widely scattered areas.

Improved transportation and communication facilities permit larger areas to be managed efficiently by a single forest supervisor. In consequence the Blackfeet Forest was partitioned between the Flathead and the Kootenai Forests; the Selway was merged with the Bitterroot, the Clearwater, the Lolo, and the Nez Perce; and the Tusayan was divided between the Kaibab and the Prescott.

National forests are required not only for timber production and watershed protection but also for such services and functions as outdoor recreation, wild-life propagation and soil-erosion control. The study conducted as a part of the survey and report of the National Resources Board in 1934 indicated that they



should be enlarged by approximately 132,000,000 acres, of which about 14,000,000 acres should be withdrawn from the unreserved public domain and 118,000,000 acres acquired from present private owners by purchase, exchange, or donation. In large part, present national-forest boundaries are arbitrary, excluding minor and marginal but integral parts of the forests, watersheds, and range lands which they were designed to protect and thus greatly increasing the difficulty and cost of management, and correspondingly diminishing its effectiveness. One of the first constructive approaches to the inauguration of a Nation-wide land-use program would lie in the extension of the national forests to their suitable limits. If that were done, approximately one-seventh of the land area of the continental United States would be under carefully planned, unified, multiple-use management, and some of what are now the most acute problems in land economy would approach solution.

#### LAND ACQUISITION THROUGH EXCHANGE

The wide interspersal among the national-forest lands of properties not under the same control creates serious problems of protection and increases the cost of administration. As has repeatedly been emphasized in former reports, one-half or more of the 250,000,000 acres of State and private lands now within the forest boundaries should be incorporated to facilitate the protection, management, and utilization of the natural resources. Adjoining the national forests are other private lands equally essential to their best development and use which should also be acquired.

One long-established and widely authorized method of acquiring such lands is through grants in exchange of not to exceed equal values of national-forest land, stumpage, or both, in the same State. There are now on the statute books 58 laws authorizing such exchanges, and there are pending before the Seventy-fourth Congress 10 additional bills to extend the provisions of the general exchange law of March 20, 1922 (42 Stat. 465), to certain described areas outside of but adjoining the national forests. This exchange work is conducted with as much care in the appraisal of offered lands as though cash were to be paid for the properties. It is carefully safeguarded by established legal requirements and has been free from valid criticism. Except where departures have been recommended by the counties concerned in order to continue the operations of logging enterprises and the employment incident thereto, the rule has been followed of limiting the use of salable stumpage for exchange purposes to valuations not exceeding 10 percent of the timber sold for cash in the same State and year.

The agreement under which the State of Colorado will select approximately 70,000 acres from land now within the Routt National Forest in exchange for an equal area of widely scattered school sections progressed toward consummation. Questions of valuation of the base and selected lands somewhat retarded the progress of the pending exchange with the State of New Mexico, but hope exists that this exchange may be consummated in the near future. Under the understanding with the State of Michigan whereby lands are purchased within established State forests with intent to exchange them for State lands within the national forests, the National Forest Reservation Commission gave approval to the purchase of approximately 160,000 acres of private lands within the State-forest limits, and the consummation of the exchanges is now well under way. The net result will be that the expenditure of Federal funds as authorized by the act of March 1, 1911 (36 Stat. 961), will place under Federal ownership lands of the full value of the expenditures, and at the same time place under State ownership lands of equal value; thus furthering both the Federal and the State programs of forest conservation in very marked degree. Similar plans might profitably be inaugurated in other States.

During the fiscal year 1935 there were reconveyed to the United States 179,613 acres of private land, valued at \$478,160, in exchange for 2,017 acres of national-forest land and 191,866,000 board feet of national-forest stumpage valued at \$418,046; the net national-forest areas thus being increased by 177,596 acres. In the same fiscal year 76 exchange cases were approved by the Secretary of Agriculture and referred to the Secretary of the Interior for further action. These cases contemplate conveyance to the United States of 124,731 acres of privately owned land in exchange for 25,063 acres of national-forest lands and \$333,113 worth of stumpage. From the beginning of the

exchange work to June 30, 1935, 1,120 land-exchange cases have been consummated. Through them the United States has acquired 1,743,521 acres of land, valued at \$6,338,060, in exchange for 464,940 acres of national-forest land, valued at \$2,034,073, and 1,287,330,000 board feet of national-forest stumpage, valued at \$3,470,144. Not only have these exchanges increased the net national-forest area by 1,278,581 acres but they have also increased the total volume of merchantable stumpage on national-forest lands, as the acquired lands support a larger volume of stumpage than that granted in exchange for them. Additionally, the passage of the acquired lands to Federal ownership and management has eliminated many difficult and expensive problems of protection, administration, and utilization.

#### LAND ACQUISITION THROUGH PURCHASE

In December 1934 an additional \$10,000,000 of the fund made available by the Emergency Conservation Act of March 31, 1933, was allotted by the President for the acquisition of forest lands under the provisions of the act of March 1, 1911. That amount, plus the unobligated balance of the \$20,000,000 previously allotted, made possible a program of land acquisition through purchase closely approaching that of the preceding year. By the creation of 15 new national-forest purchase units, purchase work was initiated in the States of Indiana, Iowa, North Dakota, and Ohio, while additional units were created in other States and substantial additions were made to various units formerly established. The number of units was thus increased from 69 to 92, situated in 27 of the States east of the Great Plains and in Puerto Rico; and their gross area was increased from 31,399,662 acres to 47,941,337 acres.

The 3,661,848 acres approved for purchase during the year brought the total approved to 12,946,528<sup>1</sup> acres. An additional 159,825 acres was approved for purchase within 13 of the State forests of Michigan, with a view to exchanging them as explained above. Since the purchase areas include 2,227,395 acres reserved from the public domain and 252,418 acres acquired through exchange, at the close of the year the United States owned or was in process of acquiring a total of 15,586,166 acres of forest lands in the eastern half of the country, but about 24,000,000 acres more must be acquired to complete the existing system of units.

Some specific requirement or objective of public interest dictated the establishment or enlargement of each purchase unit. Those established in Ohio and Indiana were to protect important parts of the watershed of the Ohio River from further forest denudation and excessive soil erosion. The units established in Iowa likewise occupy areas where long-continued agricultural use has seriously impaired the vegetative cover and has greatly accelerated land deterioration and soil movement. The two additional units in Missouri protect important parts of the watersheds of the Black, the White, the St. Francis, the Missouri, and the Mississippi Rivers. The units in North Dakota are to permit the initiation of reforestation and afforestation activities in parts of that State where tree growth is of major importance. The Delta unit in Mississippi was designed to put under management an area of the hardwood type in that State. In Louisiana, the Kisatchie Forest was extended over a large additional acreage important for both watershed protection and timber production. The Manistee unit in Michigan was doubled in size to give proper protection to an area where timber production obviously constitutes the highest economic and social use of the land. This likewise was the objective in largely increasing the size of the Ozark unit in Arkansas, and in adding materially to the Ouachita unit in the same State. The establishment of four new units in Alabama, plus the material enlargement of the existing Alabama unit, was to make permanent the gains in forest protection initiated by private agencies unable to continue the work.

The keen interest displayed in the extension of land purchases to the Western States was manifested by the enactment by the States of California, Oregon, Montana, Idaho, and Utah of the acts of consent required under the Weeks law. Within those States now exists the most acute phase of the forest problem, because of private ownership of excessive volumes of stumpage. Driven by an impossible burden of accumulated and pyramiding carrying

<sup>1</sup> Last year's report showed a total of 9,588,884 acres approved for purchase at the close of the fiscal year 1934—an apparent discrepancy with the figures given above. Defective titles and similar causes occasionally prevent the consummation of approved purchases. The acreage involved are thereupon deducted from the totals recorded as approved. In other cases resurveys change the average figures. Thus, the totals are subject to frequent minor revisions.



charges, owners of this stumpage are seeking to liquidate it as rapidly as possible. Cutting is in excess of demand, is conducted as a rule without regard to preservation of the forest capital, is threatening the economic life of dependent communities and counties, and is creating a more or less chaotic condition in all of the forest regions of the United States. Timber manufactured at a sacrifice of stumpage values, and frequently also of working capital, by competing destructively with the products of other regions forces them in turn into uneconomic and destructive utilization. Public repossession of some of the excess stumpage of the Western States, upon terms of purchase equitable alike to the public and the private landowner, would do much to relieve this condition, and thus would stabilize and promote forestry throughout the country. It would be the soundest of public policy to acquire as promptly as possible those areas of privately owned stumpage in the West which by their location control in large measure the orderly utilization of surrounding national-forest lands. So acquired, these areas could be placed completely under sustained-yield management, their timber products would be cut only in balance with growth, their contribution to the general supply of timber would be more in proportion to their productive power and less destructively competitive with other sources of supply, and conditions would be created under which the forest lands of the United States more nearly could be placed on a sound basis of sustained-yield management.

The acquisition program continued the opportunity for emergency employment, providing additional fields for constructive work by the Civilian Conservation Corps and by men employed under the relief program. The cash paid for the lands also helped the economic situation of the local communities in marked degree.

During the year title was taken under the Weeks law, as amended by the Clarke-McNary law, to 2,027,926 acres at a cost of \$5,056,523. Purchases totaling 3,661,848 acres and creating a total obligation of \$14,542,422 were approved by the National Forest Reservation Commission. The average price was \$3.97 per acre for the lands approved for purchase and \$2.49 for the lands actually acquired, as compared with the previous average of \$3.39 and \$4.28, respectively.

At the close of the year the total actually vested in Federal ownership was 7,134,650 acres; its total cost, not including overhead, was \$26,947,338, and the average price per acre was \$3.74. The distribution of these lands is shown by States in table 5.

TABLE 5.—*Acres of timberland purchased in the fiscal year 1935 and total purchases to July 1, 1935*

State	Purchased in 1935	Average price per acre	Total purchased up to July 1935	State	Purchased in 1935	Average price per acre	Total purchased up to July 1935
	<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>		<i>Acres</i>	<i>Dollars</i>	<i>Acres</i>
Alabama.....	692	4.29	118,230	North Carolina.....	56,252	2.79	494,847
Arkansas.....	61,933	2.48	412,255	Oklahoma.....	31,491	1.57	92,280
Florida.....	197,515	2.42	443,937	Pennsylvania.....	11,207	4.25	383,745
Georgia.....	43,772	4.06	390,251	Puerto Rico.....	1,040	10.00	1,040
Illinois.....	10,374	5.36	10,374	South Carolina.....	25,774	5.05	115,411
Kentucky.....	70,645	2.57	70,835	Tennessee.....	6,431	3.40	398,770
Louisiana.....	272,553	1.92	363,811	Vermont.....	27,027	9.20	58,408
Maine.....			33,781	Virginia.....	10,399	3.45	563,049
Michigan.....	124,736	2.55	533,264	West Virginia.....	188,400	2.58	578,956
Minnesota.....	236,228	2.47	468,447	Wisconsin.....	228,124	1.98	610,428
Mississippi.....	212,139	2.43	350,772				
Missouri.....	201,782	1.88	212,225	Total.....	2,027,926	2.49	7,215,493
New Hampshire.....	9,412	5.35	510,367				

#### COORDINATION OF NATIONAL PARKS AND NATIONAL FORESTS

Three bills which would transfer large areas from a national forest to a national park status received the attention of the Seventy-fourth Congress but were not acted upon at the first session. One bill would approximately double the present Mount Olympus National Monument area and designate it the Mount Olympus National Park. A second would establish as the Kings Canyon National Park the large area comprising the Kings Canyon division of the Sequoia National Forest in California. The third would extend the boundaries

of the Grand Teton National Park in Wyoming to include a large part of Jackson Valley and about 55,000 acres of land now in the Teton National Forest. These proposals raise complicated questions, involving both local and national interests. They would involve in each case the withdrawal from industrial or commercial utilization of national resources of large volume and importance, and would to that degree affect the present or prospective regional economy. If detailed analysis of all the factors involved establishes that the areas are not of such superlative scenic quality or unique scientific, educational, and recreational value as to make them truly of national interest, and if due regard for the needs of dependent communities make controlled utilization of all the natural resources within the areas, including their recreational and inspirational values, in best accord with the public interest, the lands should remain in their present status rather than be converted into hybrid national parks not in suitable conformity with established park standards and in large measure duplicating the functions of the national forests.

#### NORTHERN PACIFIC LAND-GRANT ADJUDICATION

The suit authorized by the act of June 25, 1929, to adjudicate the equities of the Northern Pacific Railroad Co. under the land grant of July 2, 1864, the resolution of May 31, 1870, and other supplementary laws continued to receive judicial attention. The proceedings were almost wholly of a legal nature, with the Department of Justice representing the Federal Government, little participation by the Forest Service being necessary.

#### PURCHASES AND DONATIONS OF LANDS FOR ADMINISTRATIVE PURPOSES

Oftentimes suitable sites for essential administrative structures cannot be found upon national-forest land. In a number of instances local people have been glad to donate tracts to meet this need, and such donations have been accepted by the Secretary under the act of March 3, 1925 (43 Stat. 1132). In 57 instances small tracts were purchased, at a total cost of \$40,194, under the provisions of the acts of March 3, 1925 (43 Stat. 1132), and June 16, 1933 (48 Stat. 195); and 18 other purchases were in process of consummation at the close of the fiscal year.

#### SPECIAL USES

At the close of the fiscal year 38,683 special-use permits were in effect, as against 37,969 at the close of the previous year. They comprised 17,978 issued without charge and 20,705 involving an annual rental. The special-use receipts for the fiscal year 1935 were \$315,829.49, an increase of \$17,998.74 over the previous year.

For several years this report has pointed out the desirability of an increase in the maximum area of 5 acres allowable under term permits issued under the act of March 4, 1915. Experience has proved that maximum to be entirely too low to permit in many cases the best development of the occupied areas and the highest service to the public. The present method of meeting the situation where a desirable form of development requiring a larger area is in question is to issue a term permit for 5 acres and a separate terminable permit for the additional area. Such forms of use as occupancy for airplane landing fields, scientific stations of educational institutions, or high-grade resorts require substantial investments, for which insecurity of tenure is inappropriate. Term permits covering areas adequate to meet well-established needs would contribute greatly to economic development and would enlarge the income derived from the forest lands by the Federal Government and the counties. Amendment of the act of March 4, 1915, to increase the maximum area to 80 acres is greatly to be desired, in the public interest. Only in exceptional and well-justified cases would permits be issued for areas of as much as 80 acres, and the majority would not exceed the present limitation.

#### CLAIMS AND SETTLEMENT

During the fiscal year reports on applications for homestead patents totaled 61, of which 56 were favorable and 5 were unfavorable; while reports on applications for mineral patents numbered 55, of which 53 were favorable and 2 unfavorable.

Applications or appeals for the reclassification and listing of national-forest lands under the forest homestead law were negligible in number. Numerous



areas previously listed for entry under that law were recalled because of the now evident fact that they are not valuable for agricultural use and if passed to private ownership would merely create that many more submarginal farms.

During the year there were introduced in the Seventy-fourth Congress two bills which would withdraw from entry under the mining laws of the United States two areas not believed to contain appreciable mineral values, but of great importance for other forms of public use and occupancy. One bill related to a part of the Prescott National Forest in Arizona; the other to a part of the Santa Barbara National Forest in California. While withdrawing the described lands from the operation of the mining laws, the bills provide for the restoration to mineral entry of lands found by the Secretary of Agriculture to be chiefly valuable for that purpose.

#### PROTECTION FROM FIRE

The deficiency in precipitation which has been accumulating during the past 15 years reached a new peak in the great drought of 1934. It was a national calamity, and as might be expected, created an exceedingly difficult fire-control problem on the national forests. When burning conditions are critical, fires are caused by actions and events which under more normal conditions would be harmless. Consequently the number of fires is often an index of the severity of the fire danger. In 1934, 10,871 fires were fought by Forest Service crews, as compared with 6,315 in 1933 and 7,037 in 1932. While part of this great increase came from fires on new territory added to the national forests east of the Great Plains, 64 percent more fires were fought in 1934 than in 1933 in the western national forests, where no material boundary changes took place.

The continued drought, increased use of the forests for recreation, large areas of timber killed by insect infestations, and other factors are developing many of the so-called "border-line" fire forests into forests of major fire difficulty. In Wyoming, Montana, Utah, Colorado, and elsewhere national forests on which fires have been handled by cooperating local settlers with only a skeleton Forest Service organization were so endangered in 1934 that a thorough strengthening of their organizations became imperative. On forests where fire control is normally difficult, the danger was greatly intensified. In the Northern Rocky Mountain Region, for example, an unusually early and large number of lightning fires broke out before the guard stations had been manned. Between May 15 and June 10 the peak 10-day load was 150 fires; the greatest number recorded in previous years was 40. The physical difficulties incident to fire control in log-encumbered old burns, the heavy, persistent smoke blankets originating from Canadian fires and from the Pete King-McLendon Butte fire on the Selway, and particularly the persistence of low-humidity periods were other reasons for the exceptionally large total area burned in this region. In Utah, where conditions were representative of the entire Intermountain and Rocky Mountain Forest Regions, the drought was generally acknowledged as being without precedent since white settlement.

The increasing difficulties of protection, which have been discussed in former reports during the past decade, have been largely offset by improved defensive strategy and tactics. In 1934 betterments in organization, more rapid and heavier mobilization of man power, vigorous and skillful leadership, and material for initial attack proved their value. Full use of newly built roads, new trucks, and the numerous Civilian Conservation Corps and other emergency crews contributed further. For example, on one fire in the Angeles National Forest, in California, 1,400 Civilian Conservation Corps workers were thrown into action within a few hours.

In most places the Forest Service was able to meet the situation. More suppression squads—organized, trained, and equipped—were in use, ready to launch the fastest possible attack. The Ponderosa Way, a firebreak and truck trail along the Sierra Nevada, constructed in major part by Civilian Conservation Corps crews, was employed repeatedly to prevent the invasion of the timber belt by fires originating in the brush and grasslands below it. Portable radio equipment developed by the Forest Service made possible fast communication on difficult fires, in place of a slow messenger service.

Detailed studies of needs for full coverage of forest areas by an organized look-out system were completed in several regions and the needed structures supplied. Discovery has thus been materially speeded up. Supplementing this, a fresh study of the communication system of telephone lines and radio brought to light new requirements which have now largely been met, saving precious

minutes in reporting fires to the control forces. Great progress was made in detailed analysis of the needs for roads and trails to permit reaching fire-hazard areas within the time limits necessary for confining the fire to a small acreage, and many urgent needs were met through construction of the required facilities.

The results of past years of fire research are becoming increasingly valuable. A mobile fire-weather forecasting unit, operated by the Weather Bureau in cooperation with the Forest Service and manned by skilled forecasters, has proved its worth. Methods of rating fire hazard currently, developed by the forest experiment station in the northern Rockies and by other forest officers in the Intermountain Region, are in general use in those sections and are removing guesswork from decisions on the requisite intensity of preparedness measures and the weight of attack to be thrown against fires. Technical advances such as these are resulting from carefully planned research projects aimed at specific fire-control problems. The application of findings to current practice ordinarily lags but little.

For many years the problem of fires in the exceedingly inaccessible "back country" of the northern Rockies has been recognized as one of the most perplexing facing the Forest Service. The almost unsurmountable difficulties of supply confronting the Service led to a type of fire-control strategy under which relatively small crews of men engaged in long campaigns to suppress individual fires. Fought in this way, some fires attained uncontrollable size, and the area burned over at times became very large. While forest values per acre were not so high as in many of the more accessible national forests, this basic strategy made the total losses entirely too heavy. This whole problem, studied anew in the field by a representative committee in 1932, was examined at a staff conference in April 1935. The decision was reached to apply to "back country" fires principles and practices similar to those long used elsewhere on the national forests.

These call for quick attack, with forces calculated to control the fire before the active burning period of the day following discovery. Analysis of actual results on thousands of fires shows that the sum total of fire costs, made up of preparedness expenses, suppression costs, and damage, tend to be markedly lower with aggressive handling of fires than when long campaigns and sacrifice of acreage are involved. This expansion into new territories of the quick-action strategy should further reduce the western fire losses. The policy has been in effect during the 1935 season, but has not yet received a severe test. However, the cumulative effect of past emphasis on quick control of all fires is increasingly evident. One way in which the Forest Service judges the technical success of fire control is the extent to which fires that continue to spread during the day after discovery are eliminated. A sharp reduction in the number of such fires indicates increasing ability to mobilize, develop strategy, and execute control action. The new expansion of the quick-control policy evidently has been a factor.

An additional year's use of Civilian Conservation Corps crews on thousands of fires permits a reasoned judgment as to the value and limitations of this organization in fire suppression. When organized into suppression squads intensively trained in the technic of fire fighting and led by experienced foremen, the Civilian Conservation Corps men learn quickly, have high morale, and develop into effective and skilled suppression crews. Willingness to work at a fast pace on short campaigns and to follow trained leaders into difficult situations are characteristics. When the leadership is not fully trained in fire control because of the necessity of selecting many foremen without adequate fire-suppression experience, the Civilian Conservation Corps crews are similar to other crews so led.

The Civilian Conservation Corps enrollees are most effective on short, sharp suppression jobs. On campaigns lasting over 4 or 5 days and involving night shifts in difficult and dangerous country, when the stimulus of excitement has disappeared and cumulative fatigue becomes important, the output drops markedly, falling definitely below that of older, more seasoned men, who readily adapt themselves to a protracted, unpleasant, and fatiguing job.

The basic organization of the Civilian Conservation Corps project, with large camps and a limited number of spike camps, results in spotty and incomplete coverage of the areas of fire danger. The regular fire-suppression organization of the Forest Service is built on the fact that a large number of suppression units of one or a few men each catches more small fires than fewer units of more men. Thus, the basic organization of the Civilian Conservation Corps precludes its fully replacing the regular fire-control organization. But it has made for a very substantial gain in catching small fires, in speeding up



suppression jobs on larger fires, and in substituting trained and organized crews for the pick-up crews formerly used. In the preparedness phase of fire control also—the construction of truck, horse, and foot trails, look-out houses and observatories, guard cabins, firebreaks, and telephone lines, and various types of hazard reduction—the Civilian Conservation Corps contributions have been exceedingly helpful and valuable.

Table 6 shows the 1934 fire record, in comparison with that of 1933, and the 5-year average for 1930-34.

TABLE 6.—Comparison of fires on national forests, calendar years 1934, 1933, and 5-year average, 1930-34

Item	Fires			Percentage of total		
	1934	1933	Average, 1930-34	1934	1933	Average, 1930-34
<b>Class:</b>	<i>Number</i>	<i>Number</i>	<i>Number</i>			
Burns of 0.25 acre or less.....	6, 023	3, 626	4, 625	55.40	57.42	56.30
Burns of between 0.25 and 10 acres.....	3, 139	1, 777	2, 246	28.88	28.14	27.34
Burns of 10 acres and over.....	1, 709	912	1, 344	15.72	14.44	16.36
<b>Total.....</b>	<b>10, 871</b>	<b>6, 315</b>	<b>8, 215</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
<b>Cause:</b>						
Railroads.....	239	94	152	2.20	1.49	1.85
Lightning.....	4, 773	2, 367	3, 343	43.91	36.53	40.70
Incendiarism.....	1, 118	708	1, 165	10.28	11.21	14.18
Debris burning.....	550	305	373	5.06	4.83	4.54
Lumbering.....	116	90	93	1.07	1.43	1.13
Camp fires.....	991	698	829	9.11	11.05	10.09
Smokers.....	2, 582	1, 859	1, 850	23.75	28.65	22.52
Miscellaneous.....	502	304	410	4.62	4.81	4.99
<b>Total.....</b>	<b>10, 871</b>	<b>6, 315</b>	<b>8, 215</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>

Calendar year	Total area of national forest land burned over	Total damage of national forest land burned over	Total cost of fighting fires, exclusive of time of forest officers
	<i>Acres</i>	<i>Acres</i>	
1934.....	555, 309	1, 720, 365	<sup>1</sup> \$3, 175, 543
1933.....	132, 147	324, 758	<sup>2</sup> 935, 339
5-year average, 1930-34.....	346, 227	1, 322, 922	2, 069, 981

<sup>1</sup> \$1,040,507 of this amount were Emergency Conservation Works funds.

<sup>2</sup> \$593,532 of this amount were Emergency Conservation Works funds.

#### THE 1935 FIRE SEASON

Conditions during the 1935 fire season to the date of this report have been far from favorable, though less severe in most of the country than in 1934. As against an average of 6,373 fires prior to September 1 during the preceding 4 years, the number this year was 7,795. Despite the high hazard so indicated, the area burned has been not much more than half of the 5-year average. This reflects increased speed in discovery and attack and more effective suppression action. The number of "extra-period" fires—those not controlled before the burning period of the first day following discovery—was reduced practically 50 percent below the 1931-34 average for the same months; and a like reduction was made in special fire-protection costs. Better organization and training, the availability and more skillful use of Civilian Conservation Corps workers, better placement of fireguard forces under plans embodying the results of painstaking fire studies, and unusually aggressive and powerful action on those fires which could not be held to a small size by the guard forces have been among the most important reasons for the reasonably satisfactory results during the season.

Critical conditions early in the year in the Southeastern States accounted for practically half of the total area burned; usually the major losses are in the far West. One fire in Florida was swept from outside the national-forest boundary by a 45-mile gale northeast through the Ocala National Forest and Game Refuge, burning a strip from 1 to 3 miles wide and about 18 miles long. After this early period no extreme difficulties were encountered

on the national forests east of the Great Plains. The worst conditions in the West developed in the belt of country extending from the Black Hills in South Dakota through Wyoming and eastern Montana and southern Idaho to the Snake River. Here the severe cumulative effects of many years of drought, mentioned in earlier reports, have not yet been appreciably alleviated. Nevertheless, for the reasons specified above, the fires in this section were kept from getting seriously out of hand.

In 1935, only two fire fighters' lives were lost on the national forests. William Silva, a Civilian Conservation Corps enrollee, was killed on the Rogue River Forest, and Melvin Richardson, a temporary employee, on the Willamette Forest.

#### PROTECTION FROM TREE DISEASES, INSECTS, AND RODENTS

During the calendar year 1934 good progress was made in control of the white pine blister rust. Control is accomplished by the elimination of the alternate host plants of the disease—shrubs of the genus *Ribes*. It is being achieved in several ways. Where the *Ribes* are scattered and occur in known situations they are pulled by hand, care being taken to see that no portion of the roots is left and that the pulled plants are placed well above the ground. When found in dense, almost pure stands, as along streams, their foliage is sprayed with poison which permeates into the roots, thus killing the plants; or, where the terrain permits, they are rooted out with a heavy road-grader type of machine, and the bushes are windrowed and burned.

The Forest Service looks to the Bureau of Entomology and Plant Quarantine Control for the technic of control, and cooperates very closely with this Bureau in the actual operations. In northern Idaho and western Montana, the home of the western white pine, where the disease offers the greatest threat, 468,206 acres of national-forest land were cleaned of *Ribes* during the year, bringing the aggregate to more than 680,000 acres. As the area within the national forests of this region estimated to require treatment was originally 1,500,000 acres, the initial job is nearly one-half completed. In the Northeast, the Appalachians, and the Lake States, where the northern white pine occurs, national-forest lands aggregating nearly 102,000 acres were cleared of gooseberries and currants. In California and Oregon, where sugar pine—the largest of five-needled pines—is found, 119,424 acres of national-forest lands were treated. In addition, 3,000 acres in Oregon were freed of *Ribes* to give protection to two eastern white-pine experimental plantations. The large increase in the scope of this work was made possible by the Civilian Conservation Corps camps and the availability of funds from the Public Works Administration.

Bark beetle epidemics continued through the calendar year 1934. In California there was a marked increase in infestations by the western pine beetle in the east side ponderosa pine stands on the Modoc, Lassen, and Piumas Forests, ranging from 20 to 80 percent over 1933. On one tract on the Modoc, treatment in 1933 had failed to check this rising infestation to any appreciable extent. In general, however, the new infestations on treated tracts were much below those on untreated lands. A noteworthy development on these forests was the extension of heavy infestations into the better site areas, and even into adjoining west-side stands, where formerly endemic conditions prevailed. Except for this overlap from east-side infestations, ponderosa pine stands on the west side remained about the same as in 1933, and conditions were generally endemic.

On the Stanislaus and Sierra Forests, where control work was done in 1933, endemic conditions prevailed for the most part. Five newly infested areas of moderate size were treated on the Stanislaus, two of which were adjacent to and partly within the Yosemite National Park and were cooperatively handled by the Park Service and the Forest Service. No new epidemics developed on the Sierra Forest. In all, 13,333 trees were treated on the national forests of California in 1934.

Conditions in Oregon did not vary greatly from those in California. The same marked increase of the western pine beetle infestations occurred in ponderosa pine stands. Control work was done on the Ochoco, Deschutes, and Rogue River Forests. The mountain-pine beetle infestation in lodgepole pine in the vicinity of Sun River Pass, on the Rogue River Forest, mentioned in last year's report, required maintenance control to prevent further increase. In all, 12,905 trees were treated during the year.

In the spring of 1934 treatment was again given to Douglas fir stands along the north fork of the Shoshone River, in the Shoshone National Forest, Wyo.



This was the first time spring treatment had been tried; the fact that no fall work was necessary on the same areas speaks well for this treatment. The advantage of spring control is that the parasites of the *Dendroctonus* beetles have emerged when the trees are treated, and are therefore not destroyed; in the fall the larvae of these parasites are in the trees and are killed along with the beetles. The rather heavy control work initiated in 1933 on the Medicine Bow Forest, Wyo., was continued in 1934. This infestation, while occurring largely in limber pine, seriously threatened valuable tie stands of lodgepole pine, since the same beetle infests both species. Occasionally epidemic conditions developed in the lodgepole pine on small areas, but prompt control measures prevented wide-spread epidemics. In Colorado the Black Hills beetle attained epidemic proportions in stands of large and valuable ponderosa pine on the Montezuma and Uncompahgre Forests, and required immediate control. Indications are that the situation is now well in hand. A total of 56,973 trees was treated during 1934 in Wyoming, Colorado, and South Dakota.

Control of the mountain pine beetle in lodgepole pine stands was continued on the Cache, Wasatch, and Ashley National Forests in southern Idaho. This infestation has been running for a number of years, and, though thought to have been under control a number of times, is constantly breaking out afresh. During the year 25,631 trees were treated. In northern Idaho no extension of the work on the Coeur d'Alene Forest was necessary, but heavy wind throw in the early spring of 1934 on areas previously treated may call for additional work on these areas. On the Kootenai Forest in Montana, 2,930 white pine trees, on six different areas infested with the mountain pine beetle, were treated in the spring and fall of 1934. This was largely maintenance control, needed as the result of heavy windfall during the winter of 1933-34.

With the continuation of drought conditions, there was no appreciable change in the status of the June beetles, which have proved such a problem in connection with reforestation in the Lake States. Before any area is selected for planting, careful tests are made to determine the grub population. Only areas are planted which show not more than two grubs to the square foot. Experiments have shown that on sites carrying no greater distribution than this, the probability of damage is relatively small.

Rabbits continued to do serious damage to the Lake States forest plantations. While in some localities the rabbit population seemed to drop off materially, in others there were apparent increases, so that on the whole the situation changed little. A carefully organized campaign waged throughout the spring, fall, and winter against the rabbits in the vicinity of all plantations very appreciably lessened the damage. Snaring and shooting have proved the most effective methods of control.

#### TIMBER

The fiscal year 1935 saw an increase in receipts and quantity of timber cut from the national forests. The cut under timber sales and land exchanges was 752,368,000 board feet, as against 674,541,000 board feet in 1934—an increase of slightly less than 12 percent. The increase in receipts amounted to about \$188,000. Practically no sales were made to supply new milling capacity. With the general strengthening of the demand for lumber, operators of national-forest timber gradually increased their production. A few new sales of moderate size were made to established operators. A liberal policy in the granting of time extensions for the completion of agreements was continued.

Under the provisions of the act of April 17, 1935, it became possible to relieve from certain contractual obligations purchasers of national-forest stumpage who, having obtained their stumpage just prior to the depression, cannot now complete the cutting and removal of the timber. The termination of agreements as authorized by this act removes certain liabilities of the purchasers for damages that jeopardized the continuance of business enterprises, and therefore of opportunities for employment. In some cases the Department had no option, without this legislation, except to bring suit for damages, although this action would almost certainly bring bankruptcies. Several large operators have taken or are taking advantage of this legislation.

With the passing of the National Recovery Administration Lumber Code, lumber prices have softened somewhat. The demand, however, has improved, largely through the placing of orders by Government agencies and through stimulated building as a result of loans under the Home Owners' Loan Corporation.

Work in timber-stand improvement through use of the Civilian Conservation Corps continued. It accomplished a decided improvement in the condition of

stands on hundreds of thousands of acres where growth was stagnated through extreme density, or the better species were being crowded out by faster-growing inferior species, or valuable species were being held back or interfered with by defective residual trees from early logging operations. Work of this type will result in shorter rotations of forest crops, a better quality of timber, and greater yields per acre, which in turn will hasten the time when a systematic sustained yield may be realized, with its attending dividends in permanent, stabilized employment.

While much has been accomplished, there are still millions of acres to be worked; and with the area of national-forest land steadily increasing, the acreage needing treatment is growing rather than diminishing. It is hoped that the work can be continued as a regular activity.

In the more densely populated regions much of the material cut in these cultural operations is available to transportation facilities and is utilized by the local inhabitants for fuel and fencing. In other cases, where some of the trees needing removal contain merchantable material but occur too scatteringly to be sold standing, the merchantable portions can be decked along the roads by the Civilian Conservation Corps workers and sold there. This utilization is encouraged.

Miscellaneous products sales of such things as gum, Christmas trees, wild shrubs, and pine cones aggregated 1,312. The number of small timber sales (transactions involving \$500 or less) was 17,380, and of large sales (transactions involving more than \$500) 140. All three classes of sales showed an increase over 1933. The demand for wood from the national forests for domestic purposes has continued to grow, and people come from long distances to the forests for their wood supplies. This demand for fuel and fencing permits of thinning crowded stands, and rids the forest of dead and down timber which otherwise would add to the fire hazard.

The national-forest timber-sale business for the fiscal year is summarized in tables 7 and 8.

TABLE 7.—Quantity and value of national-forest timber cut under sales, fiscal year 1935

State	Quantity cut			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	27,738,000		27,738,000	39,599		39,599
Arizona.....	41,137,000	472,000	41,609,000	96,236	470	96,706
Arkansas.....	23,375,000	408,000	23,783,000	221,310	408	221,718
California.....	100,646,000	1,380,000	102,026,000	250,366	1,037	251,403
Colorado.....	36,923,000	931,000	37,854,000	83,207	824	84,031
Florida.....	4,172,000		4,172,000	14,129		14,129
Georgia.....	2,160,000		2,160,000	6,547		6,547
Idaho.....	64,062,000	4,458,000	68,520,000	197,563	4,098	201,661
Louisiana.....	975,000		975,000	815		815
Maine.....	75,000		75,000	305		305
Michigan.....	5,521,000	2,000	5,523,000	10,564	2	10,566
Minnesota.....	6,671,000		6,671,000	10,705		10,705
Mississippi.....	1,747,000		1,747,000	1,508		1,508
Montana.....	18,591,000	4,016,000	22,607,000	31,019	4,387	35,406
Nevada.....	501,000	159,000	660,000	991	124	1,115
New Hampshire.....	11,357,000		11,357,000	33,154		33,154
New Mexico.....	6,996,000	868,000	7,864,000	15,360	865	16,225
North Carolina.....	19,461,000		19,461,000	36,940		36,940
Oregon.....	69,324,000	3,139,000	72,463,000	155,171	2,242	157,413
Pennsylvania.....	4,129,000		4,129,000	9,604		9,604
South Carolina.....	1,293,000		1,293,000	4,647		4,647
South Dakota.....	25,458,000	455,000	25,913,000	58,988	448	59,436
Tennessee.....	3,847,000		3,847,000	10,152		10,152
Utah.....	12,317,000	1,925,000	14,242,000	25,958	1,934	27,892
Vermont.....	1,148,000		1,148,000	5,822		5,822
Virginia.....	9,604,000		9,604,000	9,042		9,042
Washington.....	118,242,000	248,000	118,490,000	292,331	197	292,528
West Virginia.....	653,000		653,000	1,756		1,756
Wisconsin.....	1,050,000		1,050,000	1,467		1,467
Wyoming.....	29,667,000	945,000	30,612,000	75,839	907	76,746
Total, 1935.....	648,840,000	19,406,000	668,246,000	1,700,695	17,943	1,718,638
Total, 1934.....	579,789,000	18,962,000	598,751,000	1,380,125	16,620	1,396,745

<sup>1</sup> In addition, minor products not convertible into board feet were cut, the value of which was \$41,140 in 1935 and \$25,783 in 1934.



TABLE 8.—Quantity and value of national-forest timber sold, fiscal year 1935

State	Quantity sold			Value		
	Commercial sales	Cost sales	Total	Commercial sales	Cost sales	Total
	<i>Board feet</i>	<i>Board feet</i>	<i>Board feet</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Dollars</i>
Alaska.....	32,731,000		32,731,000	46,976		46,976
Arizona.....	79,035,000	534,000	79,569,000	133,606	531	134,137
Arkansas.....	37,041,000	581,000	37,622,000	210,662	581	211,243
California.....	42,643,000	1,196,000	43,839,000	71,800	930	72,730
Colorado.....	25,217,000	826,000	26,043,000	55,569	779	56,348
Florida.....	4,114,000		4,114,000	14,195		14,195
Georgia.....	2,859,000		2,859,000	7,473		7,473
Idaho.....	94,290,000	3,647,000	97,937,000	324,955	3,417	328,372
Louisiana.....	975,000		975,000	815		815
Maine.....	254,000		254,000	684		684
Michigan.....	2,098,000	4,000	2,102,000	4,141	5	4,146
Minnesota.....	3,837,000		3,837,000	6,833		6,833
Mississippi.....	3,657,000		3,657,000	3,208		3,208
Montana.....	22,208,000	4,416,000	26,624,000	43,531	4,282	47,813
Nebraska.....	2,000		2,000	3		3
Nevada.....	473,000	136,000	609,000	452	107	559
New Hampshire.....	21,119,000		21,119,000	70,543		70,543
New Mexico.....	13,529,000	860,000	14,389,000	28,102	862	28,964
North Carolina.....	21,578,000		21,578,000	26,905		26,905
Oregon.....	22,716,000	3,827,000	26,543,000	37,331	2,637	39,968
Pennsylvania.....	2,913,000		2,913,000	8,259		8,259
South Carolina.....	1,377,000		1,377,000	4,761		4,761
South Dakota.....	22,226,000	354,000	22,580,000	65,289	362	65,651
Tennessee.....	6,441,000		6,441,000	11,521		11,521
Utah.....	6,901,000	1,176,000	8,077,000	14,597	1,200	15,797
Vermont.....	666,000		666,000	2,762		2,762
Virginia.....	11,689,000		11,689,000	10,399		10,399
Washington.....	44,442,000	237,000	44,679,000	64,052	190	64,242
West Virginia.....	1,169,000		1,169,000	2,662		2,662
Wisconsin.....	1,807,000		1,807,000	2,307		2,307
Wyoming.....	120,917,000	970,000	121,887,000	262,719	923	263,642
Total, 1935.....	650,924,000	18,764,000	669,688,000	1,537,112	16,806	1,553,918
Total, 1934.....	441,828,000	20,261,000	462,089,000	1,061,686	18,227	1,079,913

<sup>1</sup> In addition, minor products not convertible into board feet were sold, valued at \$21,758 in 1935 and \$29,583 in 1934.

## PLANTING

In the calendar year 1934, more than 74,000 acres of national-forest land was planted or seeded with trees—approximately an 8-percent increase over the area so treated in 1933. The increase was not as great as was hoped for in view of the availability of emergency labor from Civilian Conservation Corps camps and allotments from the National Recovery Administration. The limiting factor was the quantity of suitable nursery stock available. Experience in 1933 had demonstrated anew the necessity for using young trees of the kind and development adapted to the specific areas to be planted; more than 15,000 acres had to be replanted, largely because of the use of purchased trees which proved to be unsuited to the conditions they encountered. The slower but far more certain method is to determine what should be planted in each case and grow the trees in a nursery for from 1 to 4 years until they meet the particular specifications.

A notable expansion of Forest Service nurseries was made in preparation for planting over 150,000 acres in the calendar year 1935. This expansion was chiefly east of the Great Plains, to make productive previously devastated portions of the newly purchased lands.

The area planted and sown on the national forests during the calendar year 1934 is shown, by States, in table 9.

TABLE 9.—*Planting and sowing on national forests, by States, calendar year 1934*

State	Area planted	Area sown	Total	State	Area planted	Area sown	Total
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>		<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Arkansas.....	1,705.0	-----	1,705.0	New Hampshire.....	141.0	-----	141.0
California.....	1,121.0	340.0	1,461.0	North Carolina.....	266.0	-----	266.0
Colorado.....	3,297.0	-----	3,297.0	Oregon.....	1,356.0	-----	1,356.0
Georgia.....	27.0	-----	27.0	Pennsylvania.....	2,615.0	-----	2,615.0
Idaho.....	2,629.0	-----	2,629.0	Tennessee.....	396.0	-----	396.0
Illinois.....	56.0	468.0	524.0	Vermont.....	750.0	-----	750.0
Louisiana.....	473.0	-----	473.0	Virginia.....	388.0	-----	388.0
Michigan.....	26,997.0	-----	26,997.0	Washington.....	4,603.0	-----	4,603.0
Minnesota.....	3,858.0	-----	3,858.0	West Virginia.....	1,100.0	-----	1,100.0
Mississippi.....	22.0	-----	22.0	Wisconsin.....	20,632.0	59.0	20,691.0
Missouri.....	83.0	13.0	96.0	Wyoming.....	309.0	-----	309.0
Montana.....	122.0	-----	122.0				
Nebraska.....	890.0	-----	890.0	Total.....	73,836.0	830.0	74,716.0

Table 10 shows the present and estimated future capacities of the national-forest nurseries. While they are designed primarily for the production of stock to be planted on the national forests, small amounts of coniferous stock from them will be used to supplement the stock grown by and for the Great Plains shelter-belt project.

TABLE 10.—*Production capacity of the national-forest nurseries*

Location	Nursery	Area	Production capacity in thousands	
			Present	Possible
		<i>Acres</i>		
Arkansas, Russelville.....	Ozark.....	14.9	1,070	3,000
California, Susanville.....	Susanville.....	7.8	540	1,500
Colorado, Monument.....	Monument.....	16.5	2,300	4,300
Louisiana, Alexandria.....	Stuart.....	112.4	10,255	50,000
Michigan:				
Manistee.....	Chittenden.....	80.0	51,350	<sup>1</sup> 45,000
East Tawas.....	Beal.....	19.0	12,000	14,000
Manistique.....	Manistique.....	84.0	27,000	<sup>1</sup> 17,000
Minnesota:				
Cass Lake.....	Cass Lake.....	19.7	12,785	<sup>1</sup> 12,655
Do.....	Lydick.....	60.0	39,000	41,000
Montana, Haugen.....	Savenac.....	26.0	6,500	10,000
Missouri, Licking.....	Licking.....	25.9	15,000	16,000
Nebraska, Halsey.....	Bessey.....	28.7	2,380	6,050
Washington, Stabler.....	Wind River.....	13.0	2,365	3,000
West Virginia, Parsons.....	Parsons.....	66.0	887	5,000
Wisconsin:				
Park Falls.....	Nepco.....	19.0	14,445	<sup>1</sup> 14,000
Rhineland.....	Rhineland.....	55.8	30,145	<sup>1</sup> 25,000
Wyoming, Laramie.....	Pole Mountain.....	11.0	225	1,000
Total.....		659.7	228,247	268,505

<sup>1</sup> Present production based largely on 1-0 and 2-0 stock. When production is placed on 3-0 and transplant-stock basis, the amount of stock it will be possible to grow will be reduced.

## RANGE

### WEATHER AND FORAGE CONDITIONS

The 1934 grazing season on the national forests was one of the worst ever known. In eastern Montana and Wyoming forage dried up so early that eventually about 50 percent of all the livestock was sold to the Government under its drought-relief program. A similar situation prevailed in the Black Hills, where the hay crop was a total failure. In Colorado the 1933-34 winter snowfall was deficient. High ranges turned brown by July, feed was short, and many springs, streams, and ponds went dry, causing a harmful



concentration of cattle near other watering places. Many irrigated fields dried up, there was little fall pasture, and little more than a 50-percent hay crop. On four forests grasshoppers were a serious pest.

In New Mexico and Arizona some areas suffered extreme drought, others received half of the normal precipitation, and a few had normal forage production. Some ranges could not be used at all during the summer. The winter ranges were generally short of feed, so that few young stock were carried over; but fall rains and much snow made prospects good for 1935.

In Idaho, Utah, and Nevada drought and high temperatures resulted in the worst grazing season on record. Many of the lower ranges were dry in April. Forage averaged about 55 percent of normal, after 10 years of drought in which a 50-percent precipitation deficiency had accumulated. In October the desert ranges were in the worst condition in 30 years. In this region, however, the supply of hay and concentrates proved adequate to bring the reduced numbers of stock through the winter in fair condition, and with normal precipitation during the winter grazing prospects were much more favorable for 1935. On April 1, 1935, the Bureau of Agricultural Economics showed ranges 67 percent of normal, cattle 78 percent, and sheep 81 percent.

In California the 1934 precipitation was 29 percent below normal, following several dry seasons. Forest ranges matured from 2 to 6 weeks early, and the volume of forage produced was approximately 70 percent of normal—a little better than in 1933. Most stock remained in good condition until August, but then lost weight rapidly for lack of adequate feed and water. Early fall rains and warm weather changed the winter condition of forage from one of the worst to one of the best that the present generation of stockmen can remember; in some places 1 acre sufficed to support a ewe and lamb until May 1.

In Washington and Oregon many springs and other water supplies heretofore dependable dried up. In general, livestock entered the range in fairly good condition, and many steers and dry cows left in good to excellent condition, but lambs and cows with calves were very commonly under weight.

In the fall the extensive Government purchases of thin cattle relieved the situation in many of the worst drought areas of the West. Stock too poor to ship was slaughtered on the range. These drought relief purchases did much to increase prices during the fall and winter, and to make reductions on overgrazed ranges much easier. In California lambs brought a cent more than in 1933, but elsewhere much the same. Good beef cattle in Montana and Idaho were slightly higher. Winter losses have been light, the seasonal condition of livestock is good or excellent, and improved prices have done much to encourage stockmen. On the other hand, the cumulative effect of several years of drought has been reduced range productivity, localized overgrazing, especially near watering places, acceleration of localized erosion, and disappointing gains in livestock weights. The repetition of adverse conditions year after year emphasizes the necessity of conserving our range resources by reducing grazing allowances, even though this meets with opposition from stockmen.

#### RANGE USE

The total number of permittees increased 1 percent, the number of cattle allowed to graze under permit nearly 2 percent, and the number of sheep increased very slightly. (See table 11.) In addition to the stock under permits there were grazed in the six western national-forest regions 60,549 cattle and horses and 8,202 sheep and goats under the regulation authorizing free grazing of not to exceed 10 head of stock used for domestic purposes, or by prospectors, campers, and travelers, or in connection with permitted operations on the national forests. A liberal policy of nonuse permits helped many distressed permittees to protect their holdings pending readjustment of their affairs.

TABLE 11.—*Grazing permits issued and numbers of stock allowed under pay permit on the national forests, by States, calendar year 1934*

State	Cattle, horses, and swine				Sheep and goats		
	Permits issued	Stock grazed			Permits issued	Stock grazed	
		Cattle	Horses	Swine		Sheep	Goats
Arizona.....	999	193, 210	1, 111	86	94	245, 189	10
Arkansas.....	22	801	-----	-----	1	-----	100
California.....	1, 625	138, 874	3, 656	70	277	355, 954	752
Colorado.....	3, 040	283, 735	2, 121	-----	904	970, 469	80
Florida.....	25	1, 458	-----	-----	-----	-----	-----
Idaho.....	2, 827	129, 828	4, 689	-----	1, 004	1, 308, 533	-----
Michigan.....	-----	-----	-----	-----	3	755	-----
Montana.....	1, 865	125, 108	5, 646	-----	420	600, 051	90
Nebraska.....	41	13, 292	445	-----	-----	-----	-----
Nevada.....	341	56, 914	1, 627	-----	126	302, 945	-----
New Hampshire.....	8	113	3	-----	-----	-----	-----
New Mexico.....	1, 962	92, 923	1, 548	19	277	200, 156	8, 082
North Carolina.....	237	1, 097	5	139	13	117	10
Oklahoma.....	50	2, 143	-----	-----	-----	-----	-----
Oregon.....	1, 164	86, 120	1, 245	-----	426	601, 616	-----
Pennsylvania.....	1	15	-----	-----	-----	-----	-----
South Dakota.....	665	27, 684	743	-----	40	26, 108	-----
Tennessee.....	57	471	14	-----	3	65	-----
Utah.....	4, 024	111, 340	3, 006	-----	1, 864	751, 190	-----
Virginia.....	67	726	4	-----	6	136	-----
Washington.....	413	14, 592	305	-----	106	142, 940	-----
West Virginia.....	45	416	10	-----	68	1, 600	-----
Wisconsin.....	20	394	-----	-----	-----	-----	-----
Wyoming.....	752	108, 133	3, 371	-----	279	644, 420	-----
Total, 1934.....	20, 250	1, 389, 387	29, 549	314	5, 911	6, 152, 244	9, 124
Total, 1933.....	19, 863	1, 366, 538	31, 797	533	5, 994	6, 150, 921	11, 045

Permit reductions because of overgrazing in former years and reduced carrying capacity amounted to 358,785 cattle- and horse-months and 645,786 sheep-months. Serious overgrazing due to the drought has necessitated still larger reductions in 1935. The demand for range by old permittees and new applicants far exceeds the range capacity on all the western forests. The livestock industry is so firmly established that stability of range use is adequately assured. Increased demand for national-forest range is due largely to the reduced carrying capacity of State and private lands caused by drought, overgrazing, and erosion, to better livestock prices, and to low national-forest grazing fees as compared with the charges made for private ranges of similar capacity. The curtailment of outside stock on Indian reservations and on some State and railroad lands through reductions for protection have increased in some cases by 50 percent the demand for national-forest range.

*Term permits.*—Table 12 shows the 1934 situation with respect to term permits. All these permits expired December 31, 1934. Term permits have led to more personal interest on the part of some permittees in their own allotments, and to more stability in their individual ranch operations, but they have also restricted action which drought and other conditions justified and have led to speculation in grazing preferences and in overcapitalization of outfits. Since unusual conditions, social, economic, and physical, demand more flexibility in grazing administration, no new 10-year permits should be issued at present. This course is necessary to restore range carrying capacity seriously lowered by overgrazing during several years of subnormal precipitation; to reduce to the minimum erosion, with its resultant silting of ditches, canals, and reservoirs; and to provide opportunity for wider distribution of grazing privileges in the light of existing conditions and local community needs.



TABLE 12.—*Livestock allowed under term or 10-year permits on the western national forests, calendar year 1934*

Region	Stock under term permits			
	Cattle and horses		Sheep and goats	
	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>
1.....	60, 168	41	239, 486	33
2.....	167, 223	41	652, 702	47
3.....	149, 098	48	256, 538	56
4.....	275, 792	77	2, 198, 805	87
5.....	45, 600	31	104, 755	29
6.....	23, 025	22	323, 251	42
Total 1934.....	720, 908	49	3, 775, 537	61
Total 1933.....	720, 177	40	3, 840, 887	62

Social welfare demands a partial redistribution of grazing privileges looking toward the establishment of a greater number of economically sound livestock home units. These will necessarily vary considerably in size in different parts of the country. In the interest of the greatest permanent good for the largest number of deserving stockmen, several years will be required to work out equitable range adjustments which will give a greater number of ranch families an opportunity to earn a decent living. For thousands of small farmers and ranchers the opportunity to increase their herds by securing a permit to run a few head of cattle or sheep on national-forest range, or slightly to increase the number already there, may mean the difference between success and failure; between paying off their mortgages or losing their homes, between keeping their families on a subsistence basis or slowly building up ranch homes that will be a credit to the community and a fitting place in which to rear children to intelligent, worth-while citizenship.

In any small business with a fixed overhead expense a small additional income may prevent failure. During these distressing years of drought, low prices, and financial difficulties, doubtless thousands of owners of ranch homes have lost their ranches who would have won out if a part of their stock could have grazed on national-forest range. In 1934 more than 31,000 families on the national forests were on relief rolls, and a like number in communities adjacent to the forests. It is apparent that careful study should be made of the extent to which range use may supplement ranch incomes to sustain homes.

Four percent of the sheep permittees now graze 22 percent of the sheep, and 7 percent of the cattle permittees graze 44 percent of the cattle. On one forest 16 permittees graze 105,000 sheep, while hundreds of small farmers in the valley are clamoring for national-forest privileges necessary to maintain small-farm flocks. Other striking examples could be quoted. Unusual financial and weather conditions have in many cases worked to the disadvantage of the small ranch owner and have increased the holdings of the larger outfits. Widespread unemployment emphasizes how essential it is to encourage and develop a maximum number of economically sound livestock home units and thus help to build up progressive communities. A further study of the distribution of range privileges is of paramount importance.

#### ADVISORY BOARDS

Cooperation with users is essential to successful administration. This is proved by 30 years of practical experience, dealing with over 700 livestock associations. Cooperation has its definite and important field. Stockmen should not finally decide, nor do they expect to do so, such vital questions as who should use the range, the number of stock to be allowed, the season of use, or the adjustment of privileges to meet varying public needs. These questions concern public interest. There are, however, questions relating purely to the care and management of livestock which concern individual interests and should be left to the advisory boards. Their ability, willingness, and spirit of fair

dealing in handling questions of this kind have been well demonstrated. The results of past cooperative efforts with advisory boards lead to the inescapable conclusion that the present course should continue to be followed by the Forest Service.

#### TRESPASSING STOCK

The number of trespassing wild horses decreased 19 percent, or from 9,204 in 1933 to 7,414 in 1934. Trespassing cattle and horses showed an increase of 3,650, or 25 percent, primarily because of drought-stricken ranges, partly because through mortgages many cattle owners lost their stock and were unable to pay their grazing fees. Trespassing sheep increased from 59,738 to 66,495, an increase of 11 percent over the number in 1933, largely because sheepmen were almost desperate in their efforts to secure sufficient feed for their flocks. While larger numbers of stock trespassed, in terms of animal-months the amount of trespass was actually reduced.

#### RANGE SURVEYS AND MANAGEMENT

During 1934, 7,832,117 acres were covered by intensive range surveys, bringing the total to 68,668,173 acres. In no other country have so extensive range surveys and so comprehensive range management and land utilization plans been conducted and put in operation as in the long-time land-use plans of the Forest Service. It is plain that the application of these scientific studies by trained men of practical experience will have a cumulative beneficial effect which it is impossible to overestimate. A series of dry years has served to emphasize the necessity for complete management plans for all of the 9,153 separate range allotments, of which 7,511 now have completed plans. In no other way can maximum production of forage be secured, overgrazing and erosion prevented, and an equitable distribution of range among permittees effected. Since on most forest ranges more than one resource is involved, management plans determine the best correlated use of the land.

Low cattle prices have made it increasingly difficult to get livestock associations to hire riders for the efficient handling of cattle.

Table 13 shows the construction of range improvements during the fiscal year 1934. Labor furnished by Civilian Conservation Corps enrollees was valued at \$546,000 and local labor on relief rolls at \$827,000. Expenditures for equipment and supplies also added much labor and other income directly and indirectly to local communities. With 31,013 families and 19,389 laborers residing within national forests on relief rolls in 1934, and a similar number on lands adjoining the forests, it is easy to see the part played by range-improvement construction in keeping men off a direct dole. The 3,785 miles of fence, 81 corrals, 596 driveways, 53 bridges, and 1,972 water developments constructed in 1934 will make available much isolated and inaccessible range, and will prevent overgrazing on other areas. The improvements constructed during the last 2 years have added to the value of grazing permits, and will have great value for many years to come.

TABLE 13.—*Number and cost of range improvements constructed on national forests, fiscal year 1934, with emergency relief funds*

Region	Fences		Corrals		Driveways		Bridges		Water developments		Miscellaneous cost	Total cost
	Miles	Dollars	Number	Dollars	Miles	Dollars	Number	Dollars	Number	Dollars	Dollars	Dollars
1.....	322	197,024	6	739	113	13,150	10	1,397	295	45,710	9,334	267,354
2.....	520	431,175	8	7,614	127	10,299	4	540	264	290,027	38,009	777,664
3.....	2,022	649,558	12	2,766	7	1,121	-----	-----	401	161,036	133,514	947,995
4.....	303	194,929	19	5,081	68	27,031	27	7,153	459	85,190	54,528	373,912
5.....	194	73,097	3	922	25	8,419	-----	-----	188	33,374	56,917	172,729
6.....	334	116,740	32	6,114	256	13,795	12	4,047	328	25,691	12,703	179,090
8.....	90	26,909	1	360	-----	-----	-----	-----	37	1,202	-----	28,471
Total:												
1934..	3,785	1,689,432	81	23,596	596	73,815	.53	13,137	1,972	642,230	305,005	2,747,215
1933..	615	130,531	34	4,567	79	5,940	5	4,852	516	57,844	23,647	227,381

Table 14 shows the losses of livestock on the national forests during the calendar year 1934. As in last year's report, cattle and horses were valued at \$30 per head, and sheep and goats at \$5. The shortage of feed caused greater losses from eating poisonous plants than in any recent year. Pro-



tracted droughts have not only curtailed the production of palatable forage but also, by leaving ground bare, have favored the spread of poisonous plants. These continue to be the greatest cause of cattle and horse losses, and predatory animals the greatest cause of sheep and goat losses.

TABLE 14.—*Livestock losses, 1934*

## CATTLE AND HORSES

Region	From poisonous plants		From predatory animals		From disease		From other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	311	\$9,330	23	\$690	78	\$2,340	472	\$14,160	884	\$26,520
2.....	2,779	83,370	107	3,210	943	28,290	1,621	48,630	5,450	163,500
3.....	543	16,200	1,096	32,880	945	28,350	5,217	156,510	7,861	234,030
4.....	2,088	62,640	138	4,140	251	7,530	1,815	54,450	4,292	128,760
5.....	419	12,570	66	1,980	172	5,160	880	26,400	1,537	46,110
6.....	207	6,210	33	990	157	4,710	466	13,980	863	25,890
Totals 1934.....	6,347	190,410	1,463	43,890	2,546	76,280	10,471	314,130	20,827	624,810
Total 1933.....	5,934	178,020	1,179	35,370	2,718	81,540	7,094	239,820	17,825	534,750

## SHEEP AND GOATS

Region	From poisonous plants		From predatory animals		From disease		From other causes		Total	
	Number	Value	Number	Value	Number	Value	Number	Value	Number	Value
1.....	3,052	\$15,260	7,523	\$37,615	1,501	\$7,505	8,416	\$42,080	20,492	\$102,460
2.....	12,009	60,045	14,294	71,470	3,368	16,840	14,040	70,200	43,711	218,555
3.....	2,871	14,355	2,454	12,270	1,252	6,260	3,052	15,260	9,629	48,145
4.....	10,115	50,575	39,069	195,345	5,224	26,120	20,129	100,645	74,537	372,685
5.....	1,805	9,025	4,637	23,185	656	3,280	4,767	23,835	11,865	59,325
6.....	4,225	21,125	10,860	54,300	3,110	15,550	11,803	59,015	29,998	149,990
Totals 1934.....	34,077	170,385	78,837	394,185	15,111	75,555	62,207	311,035	190,232	951,160
Total 1933.....	25,693	128,465	66,409	332,045	12,563	62,815	56,481	282,465	161,146	805,730

Apparently predatory animals have increased as appropriations to the Bureau of Biological Survey have been cut down and the number of trappers and hunters reduced. It should be noted that the bedding-out system of sheep management is most efficient in forage utilization, in putting gains on sheep and lambs, and in preventing overgrazing and damage to the range. An increase in the number of predatory animals adds much to the difficulty of this system of management and greatly increases the losses. Losses from disease and inclement weather were increased by inadequate feed supplies, which reduce animal resistance. While the aggregate loss, from all causes, of approximately 190,000 sheep and goats and 21,000 cattle and horses amounted to only 3 percent of the sheep and 1½ percent of the cattle, their money value, more than \$1,500,000, would go a long way toward removing the causes, were its equivalent available for the purpose.

In many instances the dry weather has intensified the ravages of increasing numbers of rodents, which have done wide-spread and serious damage to the range. Fewer hawks, owls, coyotes, badgers, weasels, and other small animals of prey probably have contributed to this increase. Rodent-control work, in cooperation with the Bureau of Biological Survey, the Civilian Conservation Corps, and public-relief programs, has been very valuable and will add much to the carrying capacity of the ranges on which this work has been done. The national-forest range area treated during 1934 was 4,006,946 acres; the area now infested is 13,353,809 acres.

## RECREATION AND WILDLIFE

Occurring as they do in almost three-fourths of all the States and embracing more than one-twelfth of the entire land area of the 48 States, the national forests are within convenient motor travel of the greater part of the population and constitute the major publicly owned areas available for outdoor recreational use. While approximately 10,000,000 acres are being maintained in relatively inaccessible condition in order to preserve their primitive qualities, by far the major part of the national forests is now readily accessible. Through the expenditures for the Civilian Conservation Corps and other work-relief projects the development of an extensive network of well constructed and maintained

roads and trails has been rapidly advanced. Except where exclusive privileges are desired, recreational use of the national forests is allowed without permit or charge, conducted with a minimum of restriction and supervision, and subject only to the restrictions essential to the protection of public health and property. In these circumstances it is but natural that many millions of people should regard the national forests as fully satisfying their requirements for various forms of outdoor recreation.

Increasing attention was given during the year to the formulation of plans of land use under which recreational occupancy could be most effectively harmonized with other uses and purposes of the national forests, and through which the areas of more than normal value for such forms of use could be so developed that they would yield optimum returns in human satisfaction, mental and physical development, and good citizenship. Previous inventories and classifications were carefully reviewed, and earlier project plans were reconsidered in the light of new human requirements, dominant economic considerations, and administrative needs. The progress made will guarantee that future recreational use of the national forests will be satisfying, well-ordered, and richly productive of social values. It will also afford the hundreds of towns and villages within or close to the national forests new means of economic life to supplement such industries as grazing, mining, and stock growing.

In all of the emergency-employment activities conducted within the national forests, the place and part of recreational use was definitely recognized. Hazard removal, roadside clean-up, planting, and like phases of the emergency work were in large measure influenced by the objective of preserving or enhancing esthetic values. With the man-power available it also was possible to establish on many new camp grounds the facilities requisite to the protection of public health and property, and to improve greatly the standard and quality of these facilities upon many of the camp grounds previously partially equipped. At the close of the fiscal year the total number of improved camp grounds was 3,016, a gain of 787 over the number the preceding year. The facilities provided make a strong appeal to most of the visitors, induce their voluntary concentration in areas of minimum hazard to public health and property, and thus in large measure make unnecessary any fear that the increasing occupancy of the national forests by summer visitors may adversely affect the public properties or interests. In certain limited areas and during periods of extreme fire risk the exclusion of the public is required, but in the main the national forests may be used during the vacation period without limitation.

During the year 3 primitive areas were established with an aggregate area of 1,438,230 acres, bringing the total number to 71 and the total area to 11,378,411 acres. Classification as a primitive area does not wholly withdraw all natural resources of the area from industrial utilization, but it does guarantee that there shall be no unnecessary modification of natural conditions or impairment of the scientific, educational, and inspirational values.

The estimated number of persons visiting or passing through the national forests during the fiscal years 1934 and 1935 is shown below.

	1934	1935
Summer-home owners and guests.....	613,495	727,637
Hotel and resort guests.....	1,014,008	1,238,998
Campers.....	2,343,132	2,395,653
Picnickers.....	4,619,171	5,323,037
Visiting motorists, horsemen, hikers, etc.....	4,649,086	7,104,686
Motorists en route elsewhere.....	24,836,206	41,725,001

Motorists of the last class, though their travel through the forests may be undertaken for purposes unrelated to the recreational opportunities along the way, incidentally enjoy the benefit of the scenic protection and provision for their needs and pleasurable passing through which national-forest administration secures. That facilities for motor travel, of which touring forms so large a part, should be constructed and maintained with due regard for aesthetic enjoyment is now a truism. In estimating the number of visiting and transient tourists, attempt is made to allow for repeated visits by the same person and for tourist travel through several forests on the same trip; but undoubtedly the record includes more or less duplication. The estimated total number making use of the national-forest recreational opportunities last year reached the incredible peak of 58,548,017.



The past year has marked an increased public interest in wildlife. This has been manifested in legislative action, both Federal and State, in the National Resources Board report, in increased demands on the part of conservation organizations for better administration, and in enlarged research programs. The Federal Government, the largest owner of land suited to the production of wildlife, must take the leadership in putting its land in a productive condition. The national forests are unique in this respect. They contain the range and an ample breeding stock. With over a million big-game animals, a variety of upland-game birds, and a nucleus of fur bearers, their potentialities are now becoming fully appreciated. In consideration, however, of the enormous area, the problems of effectively coordinated plans of use are far too great for a field organization already overburdened with emergency work and increased administrative responsibilities.

The paramount need is a trained personnel large enough to meet the responsibilities which the public expects the Forest Service to assume. The problem is better visualized by the fact that more than 80 million acres in the national forests, including those in Alaska, and unused by domestic livestock are capable of producing some species of wildlife. Every area has conditions and problems peculiar to itself. No systematic plan can be fully developed until these conditions have been carefully studied and surveyed. The work calls for a personnel equipped with special training in the field of the biological sciences, the development and application of management plans properly integrated with other resource plans, and an active and enlarged protective force. Its magnitude emphasizes the need of coordinating the forces of all interested agencies, Federal, State, and private. Jurisdictional questions must be subordinated to whatever is in the interest of wildlife. Not only must forces be combined, but selfish and political considerations must be eliminated.

Table 15, while indicative of the numbers and species of big-game animals and the estimated increase or decrease over the number in previous years, falls far short of illustrating the potentialities.

TABLE 15.—*Number of big-game animals on national forests, by States, estimated as of Dec. 31, 1934*

State	Antelope	Bear		Deer	Elk	Moose	Mountain goats	Mountain sheep
		Black or brown	Grizzly					
Alabama.....				750				
Alaska.....		6,200	14,500	47,500	50	520	5,220	1,525
Arizona.....	5,040	790	7	91,050	4,721			188
Arkansas.....		8		2,710				
California.....	2,220	11,431		256,950	121			442
Colorado.....	224	3,362	3	59,570	15,276			3,002
Florida.....		180		4,350				
Georgia.....		3		450				
Idaho.....	4,116	4,999	55	63,597	11,706	597	3,463	1,891
Louisiana.....				271				
Maine.....		23		200				
Michigan.....		515		18,964	7	106		
Minnesota.....		1,655		14,700	10	2,470		
Mississippi.....				113				
Montana.....	1,106	5,642	455	55,777	20,420	1,955	4,190	1,581
Nebraska.....				167				
Nevada.....	220	2		11,253	60			170
New Hampshire.....		430		2,158				
New Mexico.....	930	1,275	3	97,400	1,302			106
North Carolina.....		568		3,737	15			
Oklahoma.....		4		1,000	345			
Oregon.....	430	5,621		88,607	13,068			50
Pennsylvania.....		247		26,758	15			
South Carolina.....		50		2,010				
South Dakota.....	12			5,055	222		16	
Tennessee.....		83		465				
Utah.....	100	601	4	80,860	3,186			159
Vermont.....		25		400				
Virginia.....		439		1,034	20			
Washington.....		8,225	6	36,343	9,308		5,073	6
West Virginia.....		683		1,950				
Wisconsin.....		307		35,052	1	1		
Wyoming.....	615	1,753	139	27,215	40,785	2,478		4,025
Total, 1934.....	15,013	55,122	5,172	1,038,416	120,638	8,127	17,962	13,145
Total, 1933.....	14,458	55,840	5,221	938,332	115,197	8,084	20,183	12,150

<sup>1</sup> Includes Alaska brown bear.

## WATER POWER

The year brought no striking developments in the utilization of the water-power resources of the national forests. The increase in use of electric energy is gradually eliminating such surplus generating capacity as has existed, but on the whole the effect hitherto on additional water power construction in the national forests has been slight. In several sections of the West steam power generated from oil and gas still is preferred to water power.

The Forest Service, acting for the Federal Power Commission, was supervising the operations of 381 permittees or licensees at the end of the year, as against 379 a year earlier. One valuation report was made. During the year 29 applications for permits or licenses involving the use of national-forest land, or 6 more than during the preceding year, were received by the Commission. This was 69 percent of the total number of applications filed under the provisions of the Federal Water Power Act during the fiscal year.

On June 30, 1935, 205 permits issued by the Department of Agriculture, through the Forest Service, prior to the Federal Water Power Act were still in effect. Of these, 97 were permits or easements for water-power projects, with a total low-flow output of 456,717 horse power; or an average of 4,708 horsepower per permit or easement. The remaining 108 were for transmission lines only; their length within the national-forest boundaries was 965.50 miles. Of the power projects 51, with an estimated low-flow output of 431,607 horsepower, and of the transmission line cases 88, with a length of 809.02 miles within the forest boundaries, required the payment of an annual rental for the use of the national forest land. The estimated average output of power projects for which no rental was required was 25,110 horsepower, and the length within the national-forest boundaries of the similar transmission lines was 156.48 miles.

## ROADS AND TRAILS

The transportation system as planned for the national forests is shown in table 16. The forest highways are roads required primarily for public travel, while the forest-development roads and trails are primarily for the protection administration, development, and utilization of the forests. Tables 17, 18, and 19 show, by States, the miles constructed and maintained and the expenditures and apportionments of the various road funds; and table 20 shows the condition of these funds at the close of the fiscal year.

TABLE 16.—*Classification of mileage in forest road and trail system and expenditure required to complete the system to a satisfactory standard, June 30, 1935*

Class	Total	Satisfactory standard	Unsatisfactory standard	Nonexisting	Expenditure required to complete
	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Miles</i>	<i>Dollars</i>
Forest highways.....	20,924	10,302	9,213	1,409	157,181,200
Forest-development roads.....	100,024	43,076	26,561	30,387	83,085,000
Total.....	120,948	53,378	35,774	31,796	240,266,200
Trails.....	153,643	121,187	15,772	16,684	4,870,100
Total.....					245,136,300



TABLE 17.—Construction, improvement, and maintenance of roads and trails from forest road appropriations and other Federal and cooperative funds, by States, June 30, 1935

State	Fiscal year 1935				Total to June 30, 1935		Expenditures to June 30, 1935		
	Miles constructed		Miles maintained		Miles constructed		Federal funds	Cooperative funds	Total funds
	Roads	Trails	Roads	Trails	Roads	Trails			
Ala.			112.3		117.3		\$790,903.09	\$25,278.16	\$816,181.25
Alaska	20.5	100.9	248.1	523.0	275.3	866.8	8,071,144.85	329,262.27	8,400,407.12
Ariz.	277.2	59.0	4,239.8	2,548.0	3,261.3	2,128.1	13,007,316.09	1,211,987.45	14,219,303.54
Ark.	329.0		1,411.0	923.0	1,496.9	571.4	5,412,856.86	135,929.75	5,548,786.61
Calif.	1,602.5	339.4	14,126.6	21,718.8	9,683.9	12,233.6	41,331,338.94	8,603,946.53	49,935,285.47
Colo.	130.8	188.7	1,351.1	10,829.1	1,929.2	12,077.6	13,113,275.40	1,153,306.18	14,266,581.58
Fla.	95.4		962.1		1,124.6		1,712,693.37	146,179.84	1,858,873.21
Ga.			302.8	275.1	316.9	359.9	2,198,645.12	82,949.62	2,281,594.74
Idaho	1,183.3	435.3	5,185.5	23,285.7	5,630.9	22,216.9	31,529,905.76	1,902,660.14	33,432,565.90
Ill.	102.3		151.0		152.5		1,177,036.81		1,177,036.81
Kans.					3.4		2,111.51		2,111.51
Ky.	52.4		21.0		93.9		936,230.79		936,230.79
La.	72.6		303.0		383.1		503,438.37		503,438.37
Maine	1.0	3.4	13.0	22.7	13.0	89.9	316,956.69		316,956.69
Md.							70.05		70.05
Mich.	707.2		1,664.8	10.0	1,861.8		2,170,348.68	103,174.13	2,273,522.81
Minn.	278.6	83.2	730.3	78.6	979.6	696.9	2,425,105.01	295,469.78	2,720,574.79
Miss.	272.7		392.7		411.7		1,845,409.22		1,845,409.22
Mo.	178.5		349.3		369.5		1,302,817.94		1,302,817.94
Mont.	274.3	78.4	1,237.0	21,330.0	2,116.4	19,551.5	17,254,351.20	665,362.20	17,919,713.40
Nebr.	44.9		78.3		115.1		176,101.69	990.80	177,092.49
Nev.	36.3	3.5	422.4	1,799.5	656.3	940.9	2,953,781.50	171,008.04	3,124,789.54
N. H.	4.8	55.4	100.1	687.2	102.6		1,646,543.21	95,949.70	1,742,492.91
N. J.							217.71		217.71
N. Mex.	391.2	33.5	2,356.3	3,308.5	2,164.4	1,717.3	9,683,929.03	333,957.32	10,017,886.35
N. Y.							81.32		81.32
N. C.	105.8	13.8	472.3	723.4	491.4	721.4	3,525,485.45	476,994.15	4,002,449.60
N. Dak.					1.0		57.75		57.75
Okla.	27.4		115.0	1.5	102.3	16.5	506,254.33	16,186.08	522,440.41
Oreg.	662.9	528.8	10,995.5	15,760.0	6,862.6	9,817.5	28,827,856.88	8,171,854.51	36,999,711.39
Pa.	32.2	51.9	217.3	250.8	173.6	250.8	1,843,533.77	42,185.50	1,885,719.27
P. R.	9.0	17.0	2.0	17.0	16.5	54.8	581,052.86	550.00	581,602.86
S. C.	118.6		192.4	18.2	192.7	18.2	864,113.35	15,659.81	879,773.16
S. Dak.	33.1	15.0	240.0	40.5	440.0	100.1	1,807,622.01	241,605.27	2,049,227.28
Tenn.	45.0	13.0	267.2	699.8	373.6	696.8	2,926,776.13	197,596.61	3,124,372.74
Tex.	97.8				97.8		402,859.75		402,859.75
Utah	354.0	88.3	1,410.2	4,601.3	2,096.1	3,963.6	7,800,936.48	1,023,310.37	8,824,246.85
Vt.	6.2	26.0	23.4	39.2	13.4	39.2	293,092.39		293,092.39
Va.	65.3	40.0	531.0	515.2	482.1	688.0	2,754,698.47	107,195.35	2,861,893.82
Wash.	490.8	949.8	3,517.7	14,412.0	3,074.6	9,882.2	18,683,394.32	1,730,906.97	20,414,301.29
W. Va.	153.2	74.0	360.9	573.4	528.0	679.2	2,134,688.25	38,159.30	2,172,847.55
Wis.	385.3		649.6		983.0		1,471,073.22	1,820.00	1,472,893.22
Wyo.	93.0	62.6	1,033.6	5,853.7	1,335.8	2,682.9	8,190,572.37	406,632.25	8,597,204.62
Total	8,740.1	3,260.9	55,786.6	130,845.2	50,524.1	103,806.6	242,166,677.99	27,728,038.05	269,894,716.07

TABLE 18.—Distribution among the States of the road and trail apportionments for the fiscal year 1936

State	10-percent fund	Forest high-ways	Forest road development	Total
Alabama	\$7.40	\$6,347	\$8,211	\$14,565.40
Alaska	5,237.27	665,775	20,160	691,172.27
Arizona	20,105.38	419,453	133,416	572,974.38
Arkansas	23,875.83	77,293	54,164	155,332.83
California	56,301.23	1,017,952	578,314	1,652,567.23
Colorado	32,226.08	526,264	125,812	684,302.08
Florida	4,078.69	33,176	12,539	49,793.69
Georgia	1,409.86	16,543	17,347	35,299.86
Idaho	37,368.28	735,550	483,508	1,256,426.28
Illinois		4,384	14,898	19,282.00
Kentucky		5,761	11,530	17,291.00
Louisiana	122.98	11,063	7,189	18,374.98
Maine	214.88	2,195	1,106	3,515.88
Michigan	1,003.70	43,912	87,725	132,640.70

TABLE 18.—*Distribution among the States of the road and trail apportionments for the fiscal year 1936—Continued*

State	10-percent fund	Forest high-ways	Forest road development	Total
Minnesota.....	\$1,640.38	\$71,757	\$44,100	\$117,497.38
Mississippi.....	227.34	23,500	15,000	38,727.34
Missouri.....	3,277.34	17,640	28,638	48,278.00
Montana.....	15,222.25	576,332	237,314	\$28,568.25
Nebraska.....	662.96	6,921	5,763	13,346.96
Nevada.....	6,377.26	131,537	13,904	151,818.26
New Hampshire.....	3,245.34	38,430	14,375	55,050.34
New Mexico.....	10,238.74	294,338	111,384	415,960.74
North Carolina.....	3,702.91	24,920	21,224	49,846.91
Oklahoma.....	1,353.15	6,023	8,937	19,313.15
Oregon.....	22,880.16	954,042	344,208	1,321,130.16
Pennsylvania.....	1,168.50	17,731	14,681	33,580.50
Puerto Rico.....	57.75	1,045	830	1,932.75
South Carolina.....	322.10	13,299	8,000	21,621.10
South Dakota.....	7,304.15	56,563	36,441	100,308.15
Tennessee.....	1,174.40	21,224	19,979	42,377.40
Texas.....	15,916.40	15,278	8,000	23,278.00
Utah.....	494.43	239,010	62,555	317,481.40
Vermont.....	1,464.97	5,098	4,382	9,974.43
Virginia.....	32,796.33	26,750	24,884	53,998.87
Washington.....	297.25	523,812	210,843	767,451.33
West Virginia.....	223.41	23,050	31,104	54,451.25
Wisconsin.....	18,332.08	31,266	75,919	107,408.41
Wyoming.....	1,174.40	314,766	101,616	434,714.08
TOTAL.....	327,053.84	7,000,000	3,000,000	10,327,053.84

TABLE 19.—*Distribution among the States of the total road and trail apportionments, including the fiscal year 1936*

State	10-percent fund	Section 8	Federal forest road construction	Forest highways <sup>1</sup>	Forest road development <sup>2</sup>	Improvement <sup>3</sup>	Total
Alabama.....	\$1,053.31	\$15,456.04	\$1,922.31	\$86,744	\$149,689	\$31,077.06	\$285,941.72
Alaska.....	180,813.15	470,963.60	203,229.50	7,982,026	349,434		9,186,471.25
Arizona.....	721,599.18	677,956.45	490,434.11	6,619,848	2,275,203	546,278.39	11,331,314.13
Arkansas.....	168,303.16	175,126.19	128,423.38	1,011,838	959,162	295,897.47	2,738,770.20
California.....	1,841,974.57	1,464,333.82	1,201,431.20	15,959,617	8,313,193	1,518,217.76	30,298,767.35
Colorado.....	881,888.33	770,948.34	784,259.55	7,886,989	2,490,857	197,297.57	13,012,239.79
Florida.....	52,170.69	119,528.14	21,584.94	358,032	221,539	140,417.47	913,222.24
Georgia.....	15,310.62	52,393.57	130,443.73	225,845	342,274	133,229.53	898,996.45
Idaho.....	1,084,267.16	1,176,750.85	1,337,004.17	11,748,003	9,720,998	1,827,886.55	26,894,909.73
Illinois.....				29,239	20,445		46,684.00
Kansas.....	1,867.27						1,867.27
Kentucky.....	722.72			33,906	145,510		180,138.72
Louisiana.....	211.65			52,531	73,135	38,132.47	164,010.12
Maine.....	4,370.18	32.41	3,738.77	32,663	39,078	21,909.56	101,791.92
Maryland.....	70.05						70.05
Michigan.....	6,457.86	115.63	3,000.00	268,720	475,841	164,507.86	918,642.35
Minnesota.....	47,573.51	8,036.36	108,352.03	805,159	612,348	130,848.59	1,711,817.49
Mississippi.....	266.21			82,627	118,899	8,598.45	209,890.66
Missouri.....				48,291	48,841		97,132.00
Montana.....	658,655.28	762,523.77	764,035.26	9,289,599	4,637,436	651,377.24	16,763,626.55
Nebraska.....	21,984.17	18.98		111,952	56,661	578.27	191,194.42
Nevada.....	203,457.80	192,989.88	81,491.85	2,174,266	207,151	45,878.18	2,905,234.71
New Hampshire.....	59,064.91	7,165.35	10,941.30	489,311	274,121	56,487.05	897,090.61
New Jersey.....	118.99				83		201.99
New Mexico.....	390,246.20	426,086.04	518,426.97	4,773,225	1,800,217	408,824.28	8,317,025.49
New York.....	4.00				20		24.00
North Carolina.....	47,476.83	86,336.41	176,466.28	356,185	734,707	192,530.92	1,593,702.44
North Dakota.....	43.75	7.00					50.75
Oklahoma.....	12,992.57	65.49	2,775.17	73,662	191,579	35,700.19	316,774.42
Oregon.....	1,122,317.38	1,428,785.95	1,013,981.59	14,442,070	7,025,908	876,916.07	25,903,978.99

<sup>1</sup> Includes \$3,000,000 appropriated for emergency highways within National forests, fiscal year 1931; \$5,000,000 emergency forest highways, fiscal year 1933; and \$14,600,000 for forest highways under the provision of sec. 205 of the National Industrial Act.

<sup>2</sup> Includes \$10,000,000 truck trails and trails appropriated under the provisions of sec. 205 of the National Industrial Act, fiscal year 1934; \$10,000,000 fiscal year 1935; and \$3,000,000 forest road development emergency construction.

<sup>3</sup> Includes actual road and trail expenditures made from annual funds.



TABLE 19.—*Distribution among the States of the total road and trail appropriations, including the fiscal year 1936—Continued*

State	10-percent fund	Section 8	Federal forest road construction	Forest highways	Forest road development	Improvement	Total
Pennsylvania.....	\$7,840.97	\$7,724.04	\$21.42	\$177,628	\$247,507	\$79,976.40	\$520,697.83
Puerto Rico.....	208.19	7.00	3,343.09	13,798	20,655	4,714.52	51,735.80
South Carolina.....	3,512.33	402.10	48,028.61	67,099	86,666	171.08	206,779.12
South Dakota.....	206,243.31	87,106.45	78,652.52	880,445	371,195	33,879.18	1,657,521.46
Tennessee.....	23,152.50	106,854.56	27,967.79	291,671	401,185	100,304.31	951,135.16
Texas.....				35,982	11,000		46,982.00
Utah.....	470,387.07	464,918.34	512,489.56	3,892,197	1,134,498	183,090.76	6,657,580.73
Vermont.....	981.90			22,754	58,593	10,778.15	93,107.05
Virginia.....	50,584.28	58,399.16	71,784.25	330,201	485,565	154,268.85	1,200,793.55
Washington.....	782,521.37	958,090.33	732,302.49	8,001,128	5,141,006	862,891.32	16,478,839.51
West Virginia.....	6,805.00	12,830.41	5,049.24	190,696	332,987	208,604.94	806,972.59
Wisconsin.....	311.77			140,110	299,027	98,415.88	537,897.65
Wyoming.....	515,953.82	468,056.34	538,468.91	5,066,823	1,666,377	102,815.87	8,358,494.94
TOTAL.....	9,594,124.01	10,000,000.00	9,000,000.00	104,100,000	51,600,000	9,161,997.19	193,456,121.20

TABLE 20.—*Condition of forest-road funds on June 30, 1935*

Fund	Appropriations	Expenditures	Balance
Ten-percent.....	\$9,266,485.15	\$8,673,378.27	\$593,106.88
Section 8.....	10,000,000.00	10,000,000.00	-----
Federal forest road construction.....	9,000,000.00	9,000,000.00	-----
Forest highways <sup>1</sup> .....	81,917,400.00	76,966,629.87	24,950,707.13
Forest highways—N. R. A.....	14,600,000.00	12,801,733.93	1,798,266.07
Forest road development <sup>1</sup> .....	38,500,000.00	37,422,479.56	1,077,520.44
Forest road development—N. R. A.....	10,100,000.00	9,807,018.38	292,981.62
Improvement <sup>1</sup> .....	9,161,997.19	9,161,997.19	-----
Total.....	182,545,882.34	173,833,300.20	8,712,582.14

<sup>1</sup> Includes emergency funds.<sup>2</sup> Includes \$2,754.82 returned to the Treasury.

The Civilian Conservation Corps accomplished considerable truck-trail and trail construction. From camps located on the national forests 6,402 miles of truck trails and 933 miles of trails were constructed, and 24,979 miles of the former and 13,801 of the latter were maintained. This helped considerably toward completing the planned road and trail system of the national forests and maintaining the truck trails and trails to a more satisfactory standard.

There was available from the Public Works Administration \$9,800,000 for forest highways and \$3,838,000 for the development system. These funds were expended in the same manner as the regular forest-highway and forest-development funds. The latter is practically all expended, and the former will be expended during the present fiscal year.

#### MAPS AND SURVEYS

The Forest Service compiled, traced or revised, and had published for official use twenty-seven ¼-inch-scale administrative maps and seventeen ½-inch-scale administrative maps. In addition there were published the following: State maps of Oregon and Washington, each in four parts on a ¼-inch scale; two California quadrangles showing vegetation types in colors; an index map of region 3 (Southwestern region) in colors, scale 1 inch equals 20 miles; a map of the Prescott National Forest, Ariz., to accompany an Executive order; and 48 miscellaneous small maps, charts, tables, graphs, and illustrations.

Survey mapping projects were completed on approximately 2,767 square miles of the national forests in the Western States, to the accuracy and scale required to meet the needs of forest administration. In the Eastern and Southern States 8,944 square miles of drainage mapping by the aerial method was completed in connection with the acquisition of new forest units, and in the Superior National Forest in Minnesota, approximately 3,500 square miles of drainage mapping was done by the same methods.

## RESEARCH

Forest research is vitally important for the broad development of forestry necessary to meet the demand of the present day, and still more, the demand of the near future. The problems arising in connection with the use of the western forest ranges, those having to do with satisfactory low-cost housing, the need to find new ways of using land and employing labor in the South and elsewhere as the changes in agricultural requirements sap the old-time economic structure, the complex problems of the forest industries, the relationships between forest and water conditions, and the unexplored possibilities in connection with forest genetics, merely illustrate the fields in which research should be seeking the knowledge essential for making the best use of the forests of the whole country.

Forest-research opportunities were expanded during the year in three important ways. Emergency allotments permitted current investigative projects to be pushed forward and the physical equipment of the various research units to be built up. In consequence the research organization was able to give much cooperative assistance to the national-forest administrative organization, the Civilian Conservation Corps, the Federal Housing Administration, and other agencies by supplying specific information and technical aid in a wide variety of fields.

A second broadening of opportunity resulted from the establishment of the Rocky Mountain Forest and Range Experiment Station, serving Colorado, Wyoming, and portions of adjoining States. This station completes the chain of continental forest experiment stations authorized in the McSweeney-McNary Forest Research Act. The shelterbelt program, however, makes evidently desirable another station to serve the Great Plains region, where a myriad of problems connected with the planting of shelterbelt stands are beginning to arise.

Finally, research has been greatly facilitated in the East and South by a considerable increase in the area of experimental forest made available to Forest Service research units. These include 1,680 acres of shortleaf pine forest in southern Arkansas, given outright to the United States by the Crossett Lumber Co., specifically for research use; and 1,600 acres of typical northern hardwood forest, adjoining Williams College in Massachusetts, deeded to the Federal Government by the board of trustees as the "Lawrence Hopkins Memorial Experimental Forest." The Maine Legislature this year made possible the purchase of a portion of the Bates College Forest, on which forest-management records have been maintained for the past 12 years. Other new experimental areas include the Palustris Experimental Forest of 4,100 acres, chiefly of longleaf pine land, established on the Kisatchie National Forest in Louisiana, and two additional wilderness areas, totaling 2,500 acres, available for forest research, one in Virginia and the other in Arizona.

The funds made available for research activities during the fiscal year 1935 under various appropriation items and through executive allotments are shown in table 21, in comparison with the amounts appropriated and allotted for 1934 and appropriated for 1936.

TABLE 21.—*Appropriations and allotments of Federal funds for research, 1934-36*

Class of research	1934			1935			1936 <sup>3</sup>
	Appropriated <sup>1</sup>	Allotted <sup>2</sup>	Total	Appropriated	Allotted <sup>2</sup>	Total	Appropriated
Forest management.....	\$386, 095	\$72, 426	\$458, 521	\$392, 810	\$219, 949	\$612, 759	\$504, 494
Range investigations.....	78, 386	47, 367	125, 753	81, 025	126, 811	207, 836	154, 435
Forest products.....	444, 376	-----	444, 376	459, 725	214, 610	674, 335	508, 361
Forest survey.....	125, 205	275, 749	400, 954	118, 543	757, 738	876, 281	250, 000
Forest economics.....	47, 126	15, 566	62, 692	48, 493	40, 768	89, 261	73, 255
Erosion and stream flow.....	65, 341	40, 535	105, 876	67, 642	226, 261	293, 903	99, 152
Forest taxation and insurance.....	35, 759	-----	35, 759	45, 000	-----	45, 000	45, 000

<sup>1</sup> Amounts made available by the Agricultural Appropriation Act less the amount withheld under the provisions of the Economy Act and by the Bureau of the Budget.

<sup>2</sup> Amounts made available through allotments from emergency appropriations, in part subsequent to the preparation of last year's report.

<sup>3</sup> It is not practicable at this time to include the total of emergency allotments which will be available for research during the fiscal year 1936.

<sup>4</sup> Allocated from National Industrial Recovery Act funds in lieu of regular appropriations.



## FOREST ECONOMICS

For a number of years progress in the application of forest management and the adoption of sound industrial and social plans in forest regions has been evidently impeded by the lack of essential forest-economics data. Investigations of the Division of Forest Economics during the year have been primarily designed to obtain and interpret data of the character needed and called for by public administrators, economists, and industrialists.

The wide-spread reversion of cut-over forest land to public ownership through tax delinquency constitutes a serious economic and fiscal problem, particularly in the Lake States, the South, and the Pacific Northwest, where studies of this subject were continued. Accurate knowledge of the character and amount of forest land that is being abandoned and of the reasons for its abandonment is essential for the proper shaping of public policy. Data of this character are being obtained and are being used by such agencies as State forestry commissions, conservation boards, and planning boards; the Land Policy Section and the regional planning boards of the Agricultural Adjustment Administration; various units of the Federal Government concerned with reorganization and improvement of local governmental functions and better land use; chambers of commerce, county courts, and other county officials; and universities.

Facts bearing upon the instability of forest-land ownership in the Douglas-fir region were published in map and mimeograph form. These included data on the character of ownership; the status of tax delinquency; trends in tax base, levies, and collections and in public debt; and the dependence upon forests for tax revenue and employment. Broad use has been and is being made of this information by public officials and by private persons. In addition, the relation between topography, soil, cover, ownership, and tax delinquency in sample areas was investigated. Members of the staff officially and actively participated in regional and State land-planning activities, and acted in an advisory capacity in formulating principles affecting the use of land and in drafting remedial legislation. As a result a number of constructive forest and other land measures were passed by the 1935 legislative assemblies of Oregon and Washington.

Foresters have long believed that conservation of the forests will be promoted by selective or partial cutting instead of indiscriminate clear cutting. Lumbermen have practiced clear cutting because they thought that anything which added to the volume obtained would help to carry overhead costs. Studies of production costs and values for trees of various sizes, which are being conducted in the Pacific Northwest, California, the northern Rocky Mountain region, the Lake States, and the South, are demonstrating the financial disadvantages of cutting the smaller trees.

These studies have demonstrated in California that the lumbermen have been losing money in direct costs on every tree cut below 22 to 30 inches in diameter, depending upon the species. For pine trees 12 inches in diameter this loss may be as much as \$10 per thousand board-feet. A report on selective timber management in the Douglas-fir region was prepared for publication. Further studies are under way. The report shows that selective timber management, either by means of individual tree selection or by group selection brings higher financial returns to the operator and is the best means of maintaining production. As a result of this study the Forest Service is preparing to demonstrate the practicability of these methods on selected areas of the national forests, and some private operators are already applying the methods recommended. A bulletin, *Application of Selective Logging to a Ponderosa Pine Operation in Western Montana*, was published cooperatively with the Montana State University. The accumulated results of studies in this region are being applied by the largest private owners of timberland in Montana.

In the South, studies in second-growth shortleaf-loblolly pine have shown that selective logging of small volumes per acre is feasible and profitable. Such cutting not only affords an immediate financial return but also assures stand improvement and future cuts of high-quality timber. These results have promoted the adoption of selective methods of cutting by a number of large owners of second-growth pine. Studies to determine profitable utilization of worked-out turpentine timber in the naval stores region were continued. A progress report on pulpwood is being prepared. The demonstration of such facts in widely separated forest regions of the country vitally touches the pocketbook of the industry and is winning attention which considerations of public interest did not get.

A report on the forest-fire-insurance investigations in the Pacific Coast States was prepared for publication. A supplementary investigation to facili-

tate the setting up of forest-fire insurance on a Nation-wide basis was initiated in the Northeast.

Records of 1934 stumpage and log prices in all forest regions were compiled. Preliminary data were furnished to governmental and private agencies at their request.

In the South a report entitled "Tax Delinquency of Forest Land in Arkansas" was extensively revised and brought up to date for publication by the Arkansas Agricultural Experiment Station. In connection with the Forest Survey, a study of land ownership, tax delinquency, valuation and taxation, and public finance was completed in 10 counties in southern Georgia and in 12 counties in northern Florida. These data will be correlated with data on the forest resources and on the industrial and social status of these sections, to aid in developing sound forest-land-use policies and in increasing the contribution which forests make to the general welfare. In the Lake States economic studies were carried on in connection with the Forest Survey to determine the situation in regard to ownership and tax delinquency of forest lands in northern Minnesota and Michigan.

#### THE FOREST SURVEY

The demand is constantly increasing for the detailed information that is being gathered by the Forest Survey, not only from regions where the work is under way but also from regions where it has not yet been possible to initiate work. Substantial progress in both field and office work was made, only a small part of which could have been accomplished without the help of emergency funds. Field work was completed on more than 150 million acres, of which over 100 million acres were in the South.

About 15 million acres in the Lake States were covered by inventory crews, and detailed studies of growth, volume, and depletion were made. Field work was completed in Minnesota and a preliminary report released. Office and computational work is proceeding rapidly.

In the South the field inventory was completed for 107 million acres. Office work progressed sufficiently to permit the publication of 14 preliminary releases, principally to satisfy the demand for data on naval stores and pulpwood supplies. A preliminary report dealing with the social and economic phases of the survey as well as the inventory and requirement phases for a unit of 10 million acres in Florida is being prepared for publication. The special studies of social and economic factors needed for comprehensive regional and State reports are well under way.

In the northern Rocky Mountain region, approximately 9 million acres of forest land was mapped. The area covered includes the most broken type conditions as well as some of the most valuable timberland in the region. Cruise data were collected for practically all the merchantable timber owned by the State and large private owners in western Montana. Compilation of type areas has been done on 75 percent of the area covered. Much preliminary work has been done on the growth, drain, and requirements phases of the Forest Survey.

The major contributions of the Forest Survey in Oregon and Washington have been the release of base maps, type maps, and summaries of Survey results. Detailed 1-inch-to-the-mile type maps were prepared for 42 counties, involving a total area of about 45 million acres. Several hundred copies of these maps have been purchased by lumber and pulp companies, timber brokers, and State, Federal, and county officials such as Army engineers, Agricultural Adjustment Administration boards, State foresters, land-planning consultants, county assessors, and State tax commissions. In addition, a very large number of the maps have been used by administrative officers of the Forest Service. State cover-type maps for the western portions of Oregon and Washington were made at  $\frac{1}{4}$ -inch-to-the-mile scale and are being lithographed in colors. Over 1,000 copies of Forest Research Notes No. 13, which recapitulates the inventory data for the Douglas fir region, and voluminous compilations of inventory data of a more detailed nature were published and distributed. A large number of requests for special statistical and map data were met. For the Douglas fir region all computations and recapitulations for both the depletion and the growth phases were completed, and the final unit reports covering inventory, growth, and depletion, with analyses of these and related economic data and recommendations, were prepared in tentative form for the 11 national forests in that region. East of the Cascades in Washington and Oregon, type mapping and cruising were completed for 10½



million acres of forest land. It was necessary to cover more than 40 million acres of different types of land in order to get the data for this area.

In California, cover-type maps of over 4 million acres were completed and prepared for publication. These maps have been of wide-spread usefulness to a large variety of agencies, including National and State land agencies and planning commissions, universities, private firms, and individuals.

A survey of lumber and other forest products used in rural construction in sample counties in 26 States was completed, the data tabulated, and analysis begun. The indications are that lumber used on farms during the past 5 years has been about 40 percent of that normally required for repairs and replacements. Studies of lumber requirements for urban construction, particularly housing, were continued.

A study of lumber used in 1933 by secondary wood-using industries, which was begun last year in response to a request from the Lumber Code Authority, was completed and the results published.

#### FOREST TAXATION

The principal conclusions of the Forest Taxation Inquiry were summarized and published in circular form. A comprehensive report containing these conclusions in full, with the underlying theoretical and factual background, is in course of publication. The taxation staff has cooperated with local agencies in several States in the study of forest-tax problems, and has advised in connection with the drafting of proposed forest-tax laws.

#### FOREST-MANAGEMENT INVESTIGATIONS

A new milestone in the development of forest-management research has just been reached as the Forest Service acquires by gift the work and physical plant of the Institute of Forest Genetics at Placerville, Calif. This institute, formerly known as the "Eddy Tree Breeding Institute", was founded in 1926 by James G. Eddy, a public-spirited lumberman of Seattle. Financial reverses in late years faced the institute, with the complete loss of the valuable work under way. Grants from the Carnegie Institution of Washington and temporary aid from the Bureau of Plant Industry and the Forest Service tided the institute over its most difficult period, until Congress provided for its continuance. This valuable line of investigation is now to be carried as a part of the activities of the California Forest Experiment Station. The new activity marks the first step in a program of genetical studies long contemplated by the Forest Service. Many genetical problems are pressing for solution. As soon as possible, such investigations of the southern pines, northern conifers, and eastern hardwoods will be begun to supplement the new work on western species.

#### SILVICULTURAL PRACTICES

The pressure for additional information in silvicultural measures to aid in the Civilian Conservation Corps work placed a heavy burden upon the experiment stations. In every region they have been under great pressure to release the findings of current work and to summarize past results. In some regions the station personnel has been heavily drawn upon by the administrative agencies to aid in training cultural foremen and to give advice on technical problems. A large amount of material covering practically every phase of forestry has been released, and several handbooks have been prepared. One of the earlier Civilian Conservation Corps publications on stand improvement has been revised. Other papers, issued in mimeograph form, cover such fields as direct seeding, soil scarification as a means of increasing desirable reproduction, girdling and poisoning of undesirable species and trees, weeding and clearing young plantations and dense stands of reproduction, thinning sprout stands and dense stands of young growth, releasing desirable reproduction from inferior and weed species, and pruning methods to improve quality growth. The basis is thus being laid for a type of silvicultural practice suited to American economic conditions, species, and forest sites.

Intensive studies of various factors affecting the early growth of longleaf pine seedlings reveal that root competition materially retards the rate of growth in stands of from 25 to 100 thousand seedlings per acre but that densities of from 1 to 25 thousand seedlings per acre allow normally healthy and vigorous growth. Competition from grass is also a factor. Seedlings

on areas from which the grass was removed immediately responded, showing consistently greater growth than where the grass cover had not been disturbed. A heavy growth of vegetation and dead, matted grass litter is a serious deterrent to quick reproduction on cut-over lands in the South. Seeds of slash pine usually manage to reach the mineral soil, but seeds of longleaf tend to hang up in the litter, where they are destroyed by birds, rodents, fungi, and insects, or germinate before reaching the soil. As the longleaf pine produces good seed crops only once in several years, this is a most important factor.

A branch of the Lake States Forest Experiment Station was established in 1931 in McHenry County, N. Dak., to test the feasibility of forest planting on poor, sandy, nonagricultural land, of which there are at least 300,000 acres in the State. On the basis of this work, national-forest purchase units aggregating 260,000 acres have been approved in North Dakota by the National Forest Reservation Commission. Four seasons of planting have afforded a high degree of success, despite the drought and the difficult conditions. Some species have proved unfit, but others have shown marked ability to survive and make growth. Eastern and Rocky Mountain red cedar, ponderosa pine, Scotch pine, and jack pine appear to be the best conifers, and green ash, bur oak, hackberry, American elm, and cottonwood the best hardwoods. Red cedar and green ash seem to be definitely suited for large-scale planting, both species having shown a survival of from 40 to 65 percent at the end of the third growing season. Furrow planting has been demonstrated to be suited to some species but definitely not to others. Cultivation of the planted trees for a period of from 2 to 5 years will probably be necessary.

The technique for testing the drought and heat-resistance of tree seedlings in a "drought machine", developed experimentally last year, was further improved, permitting over 600 tests to be made. One important finding was that seedlings are less resistant to the effects of high temperatures at high than at low humidities. This indicates that transpiration has a cooling effect and thus tends to protect the plant from high temperatures.

The wide-spread use of black locust in erosion-control plantings has created a demand for information as to how to grow this tree in forest nurseries. The locust seeds tend to germinate slowly and often require a period of several years for complete germination. Two ways of hastening the germination period were developed. One, developed at the Southern Forest Experiment Station, treats the seed with sulphuric acid to destroy the impermeable coat. Prompt sowing insures a high percentage of germination within a short time. At the Central States Forest Experiment Station a form of mechanical abrasion was perfected by which, with a relatively simple equipment, the seed coat is broken and so abraded as to permit water to permeate. Germination up to 90 percent has been so obtained. The value of both methods has been demonstrated by sowings on a large scale in State and Federal nurseries.

The Central States Station issued a warning against a practice, commonly advocated, of mixing conifers with black locust in an effort to reduce damage from the locust borer. Investigations show a consistent failure of conifers in such mixtures, due in part to inability to penetrate the leaf canopy of the locust.

#### SHELTERBELT INVESTIGATIONS

The launching of the shelterbelt project as a part of the drought-relief program necessitated a critical study of the Great Plains region to determine where the shelterbelt zone should be located and the conditions under which it should be established. Accordingly, a region-wide investigation was inaugurated by the Lake States Forest Experiment Station to provide orientation; a critical analysis was made of the climate, soils, geology, native vegetation, and results of past plantings. This was supplemented by a consideration of economic factors, information on tree enemies, and certain documentary material descriptive of the region. Other details collected included the accumulated trial-and-error experience of past windbreak planters and the results of similar work in other lands. The aid of many Federal, State, and private individuals was enlisted. Of special value was the work of the Division of Soil Survey of the Bureau of Chemistry and Soils, the Weather Bureau, and the dry-land stations of the Bureau of Plant Industry.

The evidence thus collected defined the possibilities of shelterbelt planting, outlined the zone in which planting was feasible, provided a broad program for shelterbelt development in the region, and furnished a more or less empirical basis upon which to proceed immediately. Planting began in the spring of 1935. A comprehensive report covering this investigation has been prepared.



## FIRE RESEARCH

Fire research continues to demonstrate its value in developing better detection, transportation, and communication systems. In the northern Rocky Mountain region, for example, fire-control measures based on investigative work were actually applied to whole groups of national forests before the research results could be published; and the national forests of this region are now covered by a system of look-outs, smoke chasers, and transportation facilities which furnish better protection at a 20-percent lower cost. Similar studies are being used as a basis for protective planning in other national-forest regions, by the National Park Service, and by some private and State timber-protective organizations. The California Forest Experiment Station practically completed a study of communication systems on the national forests of region 5 which revealed many weaknesses in the location and type of construction of telephone lines and showed that 400 miles of telephone lines should be reconstructed, 1,330 miles abandoned, and 3,243 miles of new line built.

Definite progress was made in the development of methods of measuring fire danger as the initial step in the proper planning of fire control. A visibility meter developed at the Pacific Northwest Forest Experiment Station indicates the distance in miles at which a standard smoke can be detected, thus permitting readjustment of the detection system to meet changing haze conditions. In a similar manner, though on an expanded scale, the fire-danger meter developed at the Northern Rocky Mountain Station furnished a means of interpreting into terms of current fire danger measurements of meteorological and field conditions taken at a large number of forest stations, thus permitting readjustments of the protective force. Since its first appearance, this meter has been materially improved. It is now widely employed in the northern Rocky Mountain region.

Damage studies continue to contribute materially to our knowledge of the role of fire in the forest. Studies by the Appalachian Forest Experiment Station in pitch and shortleaf pine stands showed that during a 10-year period following fire the wounded trees grew in basal area from one-fifth to one-third less than similar trees on adjacent unburned tracts. Hardwoods in the Appalachians are commonly subject to butt rot, of which 94 percent occurs in fire-scarred trees. In the Northeast, from 25 to 45 percent of such trees on the areas studied died during the year following injury. In the naval stores belt defoliation by fire results in marked reductions in gum flow; with complete defoliation the flow from longleaf pine was reduced 50 percent during the first season. Recovery appears to follow closely the recovery of the crown, and defoliated trees should not be turpentineed for at least 1 year after the damage. In the longleaf pine type, carefully controlled burning under competent supervision and under proper conditions may aid silviculturally in preparing a seedbed for the natural fall of longleaf seed, in controlling the brown-spot needle disease on some sites, and in reducing competing vegetation and excessive fire hazard. The inherent dangers of indiscriminate burning, however, are enormous, and considerable additional study is necessary before burning can be properly evaluated as a silvicultural tool.

## EROSION STREAM-FLOW INVESTIGATIONS

In 1930 Congress provided funds for soil-erosion investigations in the Department of Agriculture. These funds were administratively divided among the bureaus interested in such work—the Bureau of Chemistry and Soils, the Bureau of Agricultural Engineering, and the Forest Service. At the time of the legislation the Forest Service presented a program for erosion stream-flow investigations on forest and range lands. As the work got under way, it became evident that to supply the basic facts necessary in the management of wild lands for watershed purposes required an enlarged program providing more fully for the differences in regional problems due to dissimilar topography, climate, and soil, and especially to differences in the character, distribution, and past treatment of the natural vegetative cover. This enlarged program has accordingly been formulated.

The purpose of the program is to determine the effect of forest, brush, or range cover, or of combinations of them, on erosion and stream flow. It seeks to determine whether such vegetative cover may be used as the major means of obtaining satisfactory conditions of water flow and of controlling erosion on entire watersheds or important parts of watersheds; and, if so, whether it must

be in a virgin condition or may be modified by cutting or grazing. The program will undertake to develop methods for the conservation of soil fertility and moisture for growing forest and forage crops, and for the delivery of the maximum amounts of usable water for irrigation, municipal use, power, navigation, and other purposes; to stabilize dunes; to determine how to make waste lands productive; to protect against destructive floods, and to safeguard public and private works investments which already run into hundreds of millions of dollars. In short, it is designed to furnish for forest and range lands facts and remedial measures as a basis for action by Federal, State, and other agencies.

The work falls into two general classes:

1. *Intensive studies.*—Each of these contemplates a series of intensive measurements upon duplicate forest or range watersheds, the cover on which can be varied so that its effect may be determined. The program provides for 25 of these studies. They will need to be accompanied by other intensive investigations which break the problem down into factors, such as the amount of water used by the natural cover, and measure them separately.

2. *Supplemental studies.*—These comprise investigations on a smaller, less intensive scale, designed primarily to get at the relation of forest or range cover to both water and wind erosion and its control. In part they will be used to check under somewhat different conditions the results obtained in the intensive studies. Twenty-two of these supplemental studies are scheduled.

The program as a whole aims to provide the basic data for forest and range management not only on the national forests and other public areas but also on all privately owned nonagricultural lands. The soundness of this conception of its field has been recognized in the recent reorganization of soil-erosion work in the Department, by the very clear definition of the scope of research to be handled by the agencies most concerned—the Soil Conservation Service and the Forest Service. The research of the Soil Conservation Service is to be directed to lands primarily agricultural in character, while that of the Forest Service is to relate to forest and range lands, including the influence of plant cover on run-off, stream flow, flood control, soil-erosion control, and climate.

The Forest Service program will be carried out as part of the activities of the regional forest experiment stations.

The investigations of the year continued to build up impressive evidence of the effect of vegetative cover in reducing surface run-off and erosion and in regulating stream flow. Progress was materially expedited by the availability of labor for making major installations for watershed studies, and also in part by emergency funds that permitted the temporary employment of competent personnel trained in soils, ecology, and hydraulic engineering.

Study of the geologic record in the Centerville-Farmington section of northern Utah showed that recent floods in this vicinity have cut channels to extraordinary new depths, and have deposited debris and sediment far in excess of the previous normal rate. The origin of these floods can be traced primarily to relatively small areas in the heads of canyons which have been depleted of vegetation and denuded of plant cover by overgrazing and fire. On thickly vegetated parts of the watersheds run-off was not sufficiently concentrated to cause gulying regardless of the steepness of the slopes, though the rainfall was approximately equal. Investigations on widely separated areas in the Colorado River drainage show that on overgrazed areas the plant cover has been reduced by from 33 to 60 percent, and elsewhere has been badly damaged by logging and fire. Studies in the same locality show that the rate of erosion is affected not only by the density of vegetation but also by the vegetative type. In weed vegetation 54 percent of the area of study plots showed serious erosion, as compared with only 12.1 percent of similar plots in aspen, 15.4 percent in browse, and 27.1 percent in sagebrush.

Forest litter alone materially decreases run-off and erosion. In southern Mississippi, the application of forest litter to plots in seriously eroded fields, with a 10-percent gradient, decreased the run-off from 1 year's precipitation by more than 50 percent, and the soil loss by nearly 99 percent. The litter also materially increased the ground storage of the rainfall, despite an extremely compact and unabsorptive soil condition; even in heavy rains, ranging from 2.20 to 6.34 inches, the litter-covered soil absorbed from 32 to 88 percent more rainfall than exposed soil. In the Appalachian region, removal by fire of the litter under an old-growth pine-hardwood forest produced 10 times as great an average surface storm flow as that from adjacent unburned plots, and raking the litter off for 4 years produced 160 times as great.



The importance of proper management practices on lands devoted to multiple use was emphasized by a study on the Boise River watershed in central Idaho dealing with the effect of vegetation on the accumulation and rate of melting of snow. On many watersheds of the West a high proportion of usable stream flow originates from winter snowfall. The Boise River water users have feared that any future cutting of timber would detrimentally affect their supply of irrigation water. The study showed that in ponderosa pine with advance reproduction the forest cover does intercept up to 30 percent of the snowfall. In younger stands or in stands with broken canopies the amount is much less; and small openings between trees in the forest were found almost if not quite as effective in accumulating snow as large open areas beyond the influence of the forest. Delayed melting of the snow under the forest cover desirably retards the run-off and better distributes the peak flow. The study indicates that stands managed on short rotation, or under a system which will maintain numerous small openings in the stand rather than a continuous crown cover, will insure an optimum water yield, combined with timber production and soil protection.

Considerable progress was made in revegetation and resultant erosion control on badly gullied and eroded lands. As a result of information derived from research, some 5,500 acres were successfully reseeded on the Angeles National Forest, largely by sowing to mustard, the most effective means of establishing immediate erosion control on large burned areas in southern California. The total sown on this forest has been 32,000 acres, of which 12,500 was sown by airplane and the rest by ground crews. Gully control is being attempted by dense planting with cuttings of native willows in the gullies proper, accompanied by direct sowing of pine and oak seed on the slopes between. Direct seeding has proved effective when the seeds are not destroyed by rodents. Similar work upon the loessal soils of southern Mississippi involved the test of various preparatory operations, a study of planting technic, and a check of the suitability of various species. Some 19 tree and 14 herbaceous species have been tested to date.

One of the most valuable species is black locust. The sulphuric-acid treatment to increase the germination of its seed proved very effective in extensive field tests at Holly Springs, Miss., in 1934, approximately doubling the yield of seedlings. On the station's recommendation, the Mississippi Forest Service treated approximately 6 tons of black locust seed for use in growing seedlings for the extensive Civilian Conservation Corps gully-control work in northern Mississippi.

As a minor phase of erosion control work, both the California and the Appalachian Forest Experiment Stations worked out successful methods of road-bank control as a supplement to good road construction. Exposed banks are an unsightly drawback to roadside appearance, and active erosion on such banks increases the cost of road maintenance and has a detrimental effect on stream flow and upon the feeding conditions for game fish. Practices developed by the stations have now been put into effect on many miles of mountain roads on the national forests, and are being widely accepted by other road-building agencies.

#### FOREST-PRODUCTS INVESTIGATIONS

Large-scale readjustments of land use, reducing agricultural demand and making a larger area available for forestry, increase the need for a broader market for timber crops. The wages of hundreds of thousands of workers, the life and vigor of a large group of industries, tax revenues, and the support of local communities from one-third of the Nation's land area, will depend more and more upon finding out how to make wood meet modern technical and service requirements at a price which users are able to pay. The fact that the consumption of wood, both per capita and total, has been declining in the United States over a long period of years is a challenge that must be faced and answered. Furthermore, it is urgently important, in the period of temporary scarcity of prime large timber that looms directly ahead between times of depletion and regrowth, that the smaller sizes of trees be made more serviceable through new and improved adaptations to use, so that wood shall not lose ground permanently under the competitive pressure of other materials. All these considerations add deepening significance to the work of wood-utilization research centered at the Forest Products Laboratory.

## IMPROVEMENTS IN THE FIELD OF WOOD CONSTRUCTION

An advance made during the year which promises a larger share for forest products in the Nation's home-building program was the development of a prefabricated all-wood house-construction system. Research on various house parts has been previously reported. The search for an assembled type of housing is wide-spread but mostly in directions that lead away from the use of wood. The laboratory's system demonstrates that wood can be formed into standard-sized, easily fitted, weather-tight units that can be speedily assembled into a comfortable dwelling. These units are wall, floor, and roof panels built on the stressed-covering principle, which develops high factors of strength and rigidity in proportion to weight. They are fabricated by gluing plywood to suitable framing, and by means of specially designed mullions and interlocking joints they can be built up into houses of a wide variety of sizes and room arrangements. Electric wiring and service outlets are part of the panel construction.

A complete sample house embodying the new system was erected for demonstration purposes and aroused wide interest among architects, engineers, manufacturers, and the general public. Its assembly required only 21 hours of work by a crew of seven men. Further research is directed toward refining certain details of the system in line with manufacturing practice. Under factory methods of producing the component panels, this prefabrication system holds possibilities of low cost and satisfactory quality that may contribute largely toward solving the Nation's housing problem.

In structures of the future, plywood must play an increasing part. Its strength and nail-holding ability, the uniformity of its properties, the large, lightweight units in which it can be used, and the relatively small waste attendant on its manufacture promise that with further technical improvement and adaptation it will materially broaden the field of wood use. The laboratory purposes to promote this development vigorously. In addition to the plywood panels in the prefabricated house assembly, plywood units were used for the roof and walls of a large storage and utility building erected on the laboratory grounds. Its service will afford a test of the practicality, economy, and long-time weather resistance of this new form of industrial construction.

Accelerated exposure tests were begun to determine the durability of the newer types of plywood glued in the hot press with synthetic resins. Mechanical tests of plywood of different thicknesses and numbers of plies are in progress, having as their objective the calculation of the strength of the material with reference to various engineering and industrial uses. In preparation for a fundamental study of plywood, from log to finished material, an experimental veneer-cutting plant was installed. Objects in view include not only the production of plies of a wide range of thicknesses for fabrication and testing and the determination of the most favorable methods for cutting veneers from woods of different species, but also experiments looking toward the production of useful veneers from logs of smaller size and lower grade than are now thus utilized.

The strict requirements of modern engineering have unfavorably affected the wood market by displacing vast quantities of timber in favor of other materials in heavy construction. This tendency can be countered only by a strong and continued technical advance in timber design and fabrication, certain lines of which are already well marked out.

Glued and built-up construction offers an opportunity to utilize small sizes of lumber in the fabrication of large, strong members specially shaped and adapted for the structural use required. The advantages of laminated wood arch construction were given practical demonstration by the use of solid and box-type glued arches of 46-foot span as framework for the utility building referred to above. The cubic-foot cost of the building as a whole was low, erection was simple and rapid, and a large gain in interior working space was secured by virtue of the arched framing. Tests of full-scale duplicate arches closely checked the high strength values that had been calculated.

General data on plate-and-ring connectors for improved modern types of timber framing were supplemented by detailed tests to determine the most efficient conditions of their use. Definite information was obtained as to the proper spacing of connectors, the numbers and sizes required for given loadings, the placement of bearing rings, and other factors.

The preparation of the wood handbook was completed and the manuscript sent to press. This work, bringing together basic information on wood as a



material of construction, along with data for its use in design and for the preparation of specifications, marks an important step toward placing wood on an equivalent technical basis with other structural materials. Moreover, it will contribute directly to efficient use of wood in the Nation-wide building activity that is now under way or in prospect.

Research on coatings and treatments to improve the service of wood in construction and to reduce maintenance charges brought several new developments. The addition of flake graphite to priming paints proved effective in retarding the disintegration of paint coatings over the hard bands of Douglas fir and Southern yellow pine, thus providing a long-sought means of lengthening the service life of paints on such woods. Among the many types of good paints now on the market certain incompatible combinations were discovered when different types are used at successive repainting. The form of failure resulting from incompatibility closely resembles the early scaling of paint on houses with damp side walls. By selecting the proper repainting materials many expensive failures hitherto unexplained can be avoided. These findings open the way to further study of modern paints during long-time maintenance.

Marked fire-retarding effects were obtained by coating wood with several types of chemicals of known fire-retarding properties mixed with sodium silicate, blood albumin, artificial resins, and other binders. Such surface coatings may provide effective protection to wood in many types of construction, at a lower cost than with impregnation methods. A laboratory process for minimizing the shrinking and swelling of wood by replacing the water with nonvolatile materials such as resins and waxes was developed. The process may prove commercially practicable as a combined seasoning and antishrink impregnation treatment in certain exacting uses, such as flooring. New records were begun to determine the average service life of installations of wood treated with proprietary preservatives, by means of which it is hoped to obtain factual evaluations in a confused field of claims and counterclaims. A manual covering the theory and practice of preservative treatments of wood by pressure processes was published as a technical bulletin.

#### TIMBER-STAND IMPROVEMENT, HARVESTING, AND UTILIZATION

In plantations of northern white pine and Norway pine, dead branches were found to persist for so long a time that little or no clear lumber could be expected in rotations of less than 80 years. Loblolly and shortleaf pine were found to clear their branches more readily, especially in stands containing broad-leaved species, where the formation of clear wood begins in from 20 to 25 years. In any case, artificial pruning would afford great advantages wherever it can be made practicable. A portable power-driven pruning saw was developed, with the motor unit carried on a light drag and the circular saw mounted on a hollow extensible aluminum pole, which practically doubled the acreage that could be pruned in a day by one man—a gain of considerable importance in stands under intensive management.

The profitable use of thinnings and small trees from improvement cuttings was aided by several developments, including the construction and demonstration of simple machinery for shaping resin cups from waste-pine material, and the design of a special type of log house for subsistence-homestead projects, in which the walls are formed of small split logs set vertically.

The large amount of sample material collected in field investigations of southern lowland hardwoods was intensively studied. Without better knowledge of these woods there is danger of a further abandonment of many acres of forest land and the unemployment of additional thousands of men. Machining qualities, including turning, planing, and shaping characteristics, concerning which practically no systematic information was available, were established by carefully-controlled tests of 18 species. Some of the less used "weed" species were found to rate high, especially in turning qualities. Bottom-land white ash was found to be very inferior in quality to upland white ash, but by segregating according to structural characteristics and growth conditions much of it was proved suitable for specialized uses. Material progress was made in the development of apparatus for measuring and recording the smoothness of the dressed surface with mechanical accuracy. Such measurements in place of dependence upon a system of visual inspection will set a new standard of wood evaluation, needed by all the woodworking industries.

Hardwood species from lower elevations and the Mississippi Delta were compared as to shrinkage properties with species from the mountain sections of Tennessee and Kentucky. The data afford a new and reliable basis for estimating the quality of second-growth timber from highland and lowland areas throughout the South. Regularity of the shrinkage variation with position in the tree made possible the construction of a shrinkage diagram for white oak, showing volumetric shrinkage zones of less than 15 percent in the sapwood, but of more than 24 percent toward the center of the tree.

Logging and milling studies on which to base selective logging and other forest practices were made in hardwood stands in Virginia and West Virginia and in softwood stands in New England. The latter studies indicated that white pine trees of smaller diameter can be logged more profitably in New England than in any other region thus far covered or than trees of any other species. Four studies were made in pulpwood stands. Data obtained in these studies on costs of felling, crosscutting, trimming, transport, and peeling, together with data on knots, rate of growth, and percentage of summer wood, have direct bearing on the formulation of pulpwood grades as well as upon the determination of minimum cutting diameters.

A naval stores handbook, covering all woods operations in the production of pine gum or oleoresin, was published and is contributing to better turpentine practice on the longleaf and slash pinelands of the South. It was produced through cooperation of the Forest Service, the Bureau of Plant Industry, and the Bureau of Entomology and Plant Quarantine.

#### CHEMICAL SEASONING

Salt-seasoning methods were successfully extended to additional species and to timbers of large size. Boxed-heart 12- by 12-inch timbers of Douglas fir were kiln-dried after salt treatment to an average moisture content of 13 percent without checking. Dry check-free timbers of this size, rarely available hitherto, can logically be expected to take higher working stresses than would normally be allowed. The checking of western red cedar poles and piling has long been a serious merchandising handicap. Investigations disclosed that this class of material can be salt-seasoned to moisture-content values as low as 12 percent without checking. Noteworthy results were obtained in salt-seasoning green aspen logs, the material after salt treatment being kiln-dried from a moisture content of 110 percent of the dry weight to 20 percent in only 2 days and without degrade.

#### PULP AND PAPER

Improving and increasing the use of American woods for pulp and paper production is a major objective of forest-products research. Despite excellent progress in substituting other species, spruce is still the most extensively used pulpwood, and this is at least partly the reason why more than half the paper needs of the United States are met by importations of either pulpwood, pulp, or paper. Recently interest has centered in southern species, particularly the southern yellow pines, which are available in great quantity. Large amounts of southern pine are now being converted into kraft pulps and paper, and a sizable tonnage of bleached pine sulphate pulp has come into the market. A strong movement is also under way to develop commercial newsprint papers from the same species. The area of growth, however, is so wide and the conditions of growth so varied that broad differences which materially affect pulping properties are constantly encountered, even within the same species. Significant progress was made in evaluating these growth differences in terms of pulping quality and in developing a method of classification of wood based upon readily noticeable growth characteristics, such as rate of growth, heartwood content, and proportion of spring and summer wood. Experimental pulping tests revealed that such differences as color, strength, and fiber texture can be compensated by proper selection of pulping conditions and that what heretofore has been classed as a low-quality pulpwood can be converted into chemical pulp of relatively good quality.

In developing further the possible production of newsprint papers from southern pines a careful study was made of the grinding of young loblolly pine. Grinding variables were discovered to be of greater significance than



many of the wood properties, but green wood and wood of rapid growth containing large quantities of spring wood gave the best results.

Western species are also exceedingly important in the potential development of domestic pulpwood resources. In a systematic survey of the paper-making qualities of western species, lowland white fir pulpwood was found to compare favorably with both white spruce and western hemlock in yields and physical properties. Sulphite pulps from lowland white fir contain a relatively high percentage of alpha cellulose and suggest the possibility of their use for rayon pulps, which now comprise 40 percent of the sulphite production on the Pacific coast.

Further progress was made in the substitution of soda for lime in the sulphite process, the waste liquors from which may be readily concentrated and the chemicals recovered. At the optimum concentration of combined sulphur dioxide (2 percent), the strength properties of soda-base pulps showed an increase of 15 percent over pulps prepared with lime-base liquor.

Concurrently with pulping experiments, investigations were made of methods of bleaching, beating, and making paper from pulps from various species. Accurate control of the beating process for the production of desired qualities in a pulp was brought nearer by a new method of measuring the absorption of moisture by pulps, through an application of the standard "freeness" test. Encouraging results were attained in the use, on a laboratory scale, of bleaching solution as a pulping agent. By this method pulps amounting to from 52 to 56 percent of the weight of the wood were obtained from white spruce, the product being apparently well suited to the production of a strong glassine sheet with very little beating. A new unit for the experimental papermaking machine was designed and built, in which the sheet formation, press and calendar pressures, dryer temperatures, and section speeds can be closely controlled. This new equipment will be the basis of investigations of paper-machine effects on the quality of paper from pulps of all types.

#### OTHER CHEMICAL PRODUCTS

A distinct advance was made in processing wood waste for direct conversion into a plastic material suitable for molding into wall panels, floor tile, table tops, and smaller articles. By the new process a dense, black, impervious plastic was obtained from partially chlorinated sawdust without the necessity of steaming or digestion under pressure, and with a minimum of added materials. The sheet can be molded with a high gloss.

Investigations of lignin continued, with a view to possible adaptations of this second-largest constituent of wood to practical use. The same marked differences between hardwood and softwood lignins were disclosed in 5 species of hardwoods and 3 species of softwoods. A similarity was found among all the hardwood lignins and another among all the softwood lignins. Physicochemical methods showed the lowest molecular weight of the soluble portion of lignin to be twice the predicted chemical value. A complete chemical study of the fats, resins, and waxes, from the phloem and young growing tips of slash pine led to the isolation of numerous new bodies, and a much deeper insight into the complex biochemistry of growth compounds was obtained. Tannins and oleoresins were found to be derived from the same precursors and are thus related, but are not mutually transformable.

#### RELATED INVESTIGATIONS

Besides the leading projects already summarized, several lesser ones deserve brief mention.

Some of the lumber in the ladder used in the Lindbergh kidnaping was conclusively traced to its source by a member of the laboratory, at the request of the New Jersey State police, after a protracted technical study. A new type of instrument for determining the factors influencing forest-fire ignition and spread was developed, and eight instruments were placed in service. The instrument records duff moisture, branch-wood dryness, and wind velocity. An extensive study of the effectiveness of wood as a heat insulator was begun. The results thus far obtained indicate that a difference of even 3 or 4 percent in dryness of wood may make a difference of from 5 to 10 percent in heat conductivity. A machine was installed for the production of container board

in a wide variety of commercial and experimental types and an attack begun on problems of the fiber shipping container that have remained unanswered for 30 years.

In addition to the publications already mentioned, a technical bulletin containing revised tables of the mechanical properties of American woods was issued. A farmers' bulletin on the selection of lumber for farm and home building, a leaflet on the odor and taste-imparting qualities of wooden butter containers, and two technical bulletins, one on the properties and structure of compression wood and the other on the colloid chemistry of cellulosic materials, were completed.

#### RANGE INVESTIGATIONS

The practicability of restoring range vegetative cover on abandoned dry farms in eastern Montana was indicated by preliminary artificial reseeding tests at the Northern Rocky Mountain Forest and Range Experiment Station. Even with seedings made during the dry fall of 1933 and the succeeding droughty spring, 32 percent were considered successful in the fall of 1934, after the most severe drought for 50 years. Some deeply drilled seed that failed to germinate in 1934 finally came up in 1935, and increased the area classed as successful to 40 percent. A much higher degree of success was recorded for the seedings in the fall of 1934 and the spring of 1935. Crested wheatgrass proved the most promising species tested; but slender wheatgrass, smooth bromegrass, meadow fescue, Canada bluegrass, tall oatgrass, and Harbin lespedeza also showed economic possibilities. Reseeding may be done ordinarily at a cash outlay of about \$1 per acre for seed, although crested wheatgrass was in such wide demand in 1934 that the cost of seed increased unduly. The additional labor cost for planting is small, as it was found feasible to drill the seed without plowing or other costly preparation of the soil.

Preliminary range artificial reseeding results in the Intermountain Region in past years have been so promising that funds for an intensive attack were provided by Congress in the fiscal year 1936. The problem of restoring grass and other range vegetation is very important to the welfare of the West, and little has been done as yet toward its solution.

That overgrazing significantly increases the cost of producing range cattle in the Northern Plains was demonstrated by a grazing experiment conducted by the Northern Rocky Mountain Station in cooperation with the Bureau of Animal Industry. Shortgrass range near Miles City, Mont., produced so little forage during the severe 1934 drought that hay was required as a supplement during the summer in all of the experimental pastures. On pasture overgrazed in the average year about 25 percent, each cow required 2,027 pounds of hay, on properly grazed range 1,267 pounds, and on normally undergrazed range 848 pounds. Calves from cows on the more conservatively grazed range averaged 72 pounds heavier at weaning than those from cows on overgrazed range. The cost of range and supplemental feed per pound of calf produced in 1934 was about 8½ cents for the overgrazed lot, as against about 3¼ cents for the more conservatively grazed lot.

Preliminary studies by the Intermountain Forest and Range Experiment Station showed that the forage production of sagebrush-wheatgrass range in southern Idaho may be increased by light burning when the soil and vegetation are not too dry. Analysis of vegetative data indicates that burns of light intensity will completely kill sagebrush, without eliminating more desirable shrubs. On moderately burned areas the stand of grasses increased 24 percent the first year after burning, with both wheatgrass and junegrass gaining greatly. Analyses of soil samples show that although the effects of burns of light and medium intensities were relatively insignificant, heavy burning caused a very significant decrease in organic matter in the topsoil, accompanied by a decline in nitrogen and in moisture equivalent.

Studies of precipitation and plant growth on summer ranges in central Utah for the past 10 years indicate the importance not only of the total annual precipitation but also of the spring and early summer precipitation, in range-forage production. The amount of moisture in the soil at the time of snow disappearance, plus the precipitation that follows, up to the date grass heads appear, gives a significant index of the ultimate forage yield for the year. Extremely



uneven seasonal distribution of precipitation may cause irregular relationships, as in 1928, when forage yield was high in spite of low precipitation, and in 1930, when the reverse was true.

Both the administrative and the research organizations of the Forest Service have long recognized the urgent need for a compact, readily consultable handbook containing information regarding key plants, of vital bearing on range management, on western national-forest ranges. During the past two winters such a publication has been prepared by a group of administrative and research range experts. Features enabling ready plant identification, expressed in simple diagrammatic or pictorial form, characteristics relating to the importance of the various species, as forage for livestock and game and for erosion control, and data on reproduction, growth, and other characteristics which influence their use are included for over 300 of the more important range plants.

Literature on botanical, ecological, range management, and animal-husbandry subjects pertaining to western range problems has become so voluminous as to bewilder the research worker, the range administrator, and the stockman. Emergency funds available in Washington made possible the employment of the necessary technical and clerical help to complete a bibliography of range management in the West, listing over 9,000 American publications.

## EXPENDITURES AND RECEIPTS

The expenditures during the fiscal year were as follows:

General administration.....		\$701,159.25
Administration, protection, improvement, reforestation, and extension of national forests:		
Operating expenditures:		
Timber use.....	\$646,118.77	
Grazing use.....	774,948.27	
Recreation and land use.....	432,361.21	
Fish and game protection.....	292,250.80	
Classification, settlement, and claims.....	154,476.26	
Maintenance of truck and horse trails.....	2,241,007.13	
Maintenance of other improvements.....	806,698.53	
Subtotal.....		\$5,347,870.97
Protection expenditures:		
Fire prevention and detection.....	2,412,198.15	
Fire suppression.....	2,349,073.49	
Class total (fire).....		4,761,271.64
Protection against insects and tree diseases.....	183,579.37	
Subtotal.....		4,944,851.01
Investment expenditures:		
Construction of truck and horse trails.....	18,061,645.37	
Construction of other improvements.....	6,771,220.86	
Equipment and stores.....	12,035,290.58	
Timber surveys and plans.....	591,922.33	
Grazing surveys and plans.....	174,642.99	
Fish and game surveys and plans.....	95,800.64	
Recreational-use surveys and plans.....	162,790.21	
General surveys and maps.....	437,687.88	
Timber-stand improvement.....	1,311,801.27	
Reforestation of denuded areas.....	601,037.51	
Nurseries and planting stock.....	246,075.53	
Acquisition of land by direct purchase.....	8,979,357.65	
Acquisition of land by exchange.....	167,964.96	
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified).....	3,164,136.89	
Subtotal.....		52,701,524.67
Construction and maintenance of forest highways:		
Construction of forest highways.....	12,162,732.37	
Maintenance of forest highways.....	777,015.81	
Subtotal.....		12,939,748.18
Total, national forests.....		75,933,994.83

<sup>1</sup>In addition to the expenditure for acquisition of land by exchange, national-forest timber having an estimated value of \$219,430 was cut under agreements involving the acquisition of land and timber through exchange. The cash expenditures recorded opposite "Acquisition of land by exchange" cover merely the outlay incidental to examining lands offered for exchange and appraising the value involved.

## Plains Shelterbelt Project (including nurseries):

## Current expenditures:

General administration .....	\$77,127.62
Maintenance of other improvements .....	15,922.16
Protection against insects and tree diseases .....	46.30

Subtotal.....\$93,096.08

## Investment expenditures:

Construction of other improvements .....	142,922.84
Equipment and stores .....	118,003.74
General surveys and plans .....	379.65
Reforestation of denuded areas .....	97,421.40
Nurseries and planting stock .....	172,979.71
Acquisition of land by direct purchase .....	69,099.94
Nonstructural improvements (erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified) .....	2,991.43

Subtotal.....603,798.71

## Total, Plains Shelterbelt Project.....

\$696,894.79

## Research:

## Research current expenditures:

Forest management .....	625,409.68
Range investigations .....	285,467.89
Forest products .....	889,338.10
Forest survey .....	544,255.68
Forest economics .....	59,971.59
Erosion and stream flow .....	333,508.75
Forest taxation and insurance .....	19,156.30
Maintenance of roads and trails .....	8,765.73
Maintenance of other improvements .....	22,068.55
Fire prevention and detection on experimental areas .....	2,318.53
Insect control and other timber protection on experimental areas .....	8.36

Subtotal.....<sup>2</sup> 2,788,269.17

## Research investments:

Construction of roads and trails .....	21,553.02
Construction of other improvements .....	484,514.41
Equipment and stores .....	359,656.23
Timber surveys and plans; experimental areas .....	2,708.89
General surveys and maps; experimental areas .....	89,421.52
Timber-stand improvement; experimental areas .....	1,221.11
Reforestation of denuded areas; experimental areas .....	76.06
Grazing surveys and plans; experimental areas .....	1,881.39
Recreational surveys and plans; experimental areas .....	166.77
Nonstructural improvements; on experimental areas: (Erosion, tree-disease and insect control, fire-hazard reduction, and miscellaneous investments not otherwise classified) .....	110,153.47

Subtotal.....1,071,352.87

Total.....3,859,622.04

## Protection and reforestation of other than national-forest lands:

Tree planting in cooperation with States .....	157,957.37
Fire protection in cooperation with States .....	1,766,130.63
Protection of Oregon and California grant lands .....	85,296.91
Extension of forestry practice on State and private lands .....	2,196,445.44

Total.....4,205,830.35

## Emergency conservation work on other than national-forest lands:

State and private camp expenditures (1935) .....	21,449,657.10
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Total.....<sup>3</sup> 21,449,657.10

## Miscellaneous:

Emergency unemployment relief; general planning and direction of emergency conservation work .....	824,722.88
Emergency unemployment relief; Civil Works Administration, Federal Civil Works Administration, etc. ....	171,655.58
Tennessee Valley Authority; emergency conservation work .....	922,194.03
Insular forests, Puerto Rico; emergency conservation work .....	190,475.95
Examination and administration of power sites for Federal Power Commission .....	9,911.62
Miscellaneous cooperation with other departments, bureaus, and individuals .....	556,932.70

Total.....2,675,892.76

Grand total.....109,523,051.12

<sup>2</sup> Includes \$62,801.70 expended from Plains Shelterbelt Project funds.

<sup>3</sup> Expenditures for comparable work during fiscal year 1933, \$25,374.54, and during fiscal year 1934, \$21,590,564.44, not included in reports for those years.



The following statement shows the gross and net cash receipts from the national forests:

Gross receipts from national forests:	
From the use of timber.....	\$1,731,355.05
From the use of forage.....	1,151,152.93
From special land uses, water power, and miscellaneous receipts.....	408,803.86
Total receipts.....	\$3,291,311.84
Less payments to States:	
To Arizona and New Mexico, account school lands administered by Forest Service.....	20,773.48
To States in which national forests are located (act of May 23, 1908).....	817,634.59
Total to States.....	838,408.07
Net total receipts to United States Treasury.....	2,452,903.77

The total of the gross receipts is less by \$23,379.50 than that for the previous year. Receipts from timber increased \$208,998.86, grazing receipts decreased \$207,535.08, and miscellaneous receipts decreased \$24,843.28.

In addition to the cash receipts from timber, there should be credited the value of the timber cut under specific agreements for effecting land exchanges, estimated at \$219,430.00.











## REPORT OF THE CHIEF OF THE GRAIN FUTURES ADMINISTRATION, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
GRAIN FUTURES ADMINISTRATION,  
*Washington, D. C., August 31, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the work of the Grain Futures Administration for the fiscal year ended June 30, 1935.

Sincerely yours,

J. W. T. DUVEL, *Chief.*

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Trading in grain futures on the grain futures exchanges of the Nation was supervised by the Administration pursuant to the provisions of the Grain Futures Act during the year just ended. Trading was conducted on 12 of the 15 exchanges designated as contract markets under the act, there being no future trading in grain during the year on the Baltimore Chamber of Commerce, New York Produce Exchange, and Omaha Grain Exchange. The volume of trading in all grains combined aggregated 13,146,676,000 bushels, 15 percent below the preceding year's total, and a reduction of 35 percent from the 10-year average aggregate annual volume of 20,156,767,000 bushels. The volume of transactions in wheat futures for the year amounted to 8,096,503,000 bushels, 62 percent of the aggregate volume of trading in all grains, and a decrease of 20 percent from the previous year's volume of 10,093,259,000 bushels. The volume of trading in corn futures amounted to 3,724,895,000 bushels, 28 percent of the total volume of trading in all grains, and an increase of 12 percent over the preceding year's volume of 3,314,266,000 bushels. The volume of trading in oats futures amounted to 836,861,000 bushels, a reduction of 43 percent, as compared with the preceding year's aggregate of 1,457,085,000 bushels. The volume of trading in rye futures amounted to 425,133,000 bushels, a 14-percent decrease, as compared with the 494,660,000 bushels recorded during the previous year. The volume of trading in barley futures totaled 54,391,000 bushels, a reduction of 67 percent below the previous year's volume of 163,615,000 bushels. The volume of trading in flax futures aggregated 8,893,000 bushels, a reduction of 51 percent below the previous year's aggregate of 17,985,000 bushels.

Of the total volume of trading in all grain futures on all contract markets during the year, 86.9 percent was transacted on the Chicago Board of Trade, as compared with 85.5 percent during the preceding year. The aggregate volume of trading on the Chicago Board of Trade amounted to 11,419,354,000 bushels, a decrease of 14 percent from the previous year's 13,282,898,000-bushel aggregate. The largest daily volume of trading in all grain futures on the Chicago Board of Trade during the year was 127,610,000 bushels on August 9, 1934. The record daily volume was recorded on July 20, 1933, when total sales of all grain futures on the Chicago Board of Trade amounted to 269,413,000 bushels.

The aggregate annual volume of trading in wheat, corn, oats, rye, barley, and flax futures on each contract market upon which future trading was conducted during the year, and on all markets combined, is shown in table 1. The average, maximum, and minimum daily volume of trading in each grain future, and all futures combined, on the Chicago Board of Trade during the past year, with the respective dates, is shown in table 2. The monthly volume of trading in wheat and corn futures, respectively, on each contract market where these futures were traded in, is shown in tables 3 and 4.

TABLE 1.—*Total volume of trading in wheat, corn, oats, rye, barley, flax, and all grain futures combined on the contract markets, fiscal year ended June 30, 1935*

[In thousands of bushels; i. e., 000 omitted]

Market	Wheat	Corn	Oats	Rye	Barley	Flax	All grains
Chicago Board of Trade.....	6,797,554	3,479,921	752,363	378,945	10,571	-----	11,419,354
Chicago Open Board of Trade.....	128,029	33,630	6,041	1,103	-----	-----	168,803
Minneapolis Chamber of Commerce.....	457,401	-----	73,789	41,001	42,787	7,190	622,168
Kansas City Board of Trade.....	678,379	197,258	-----	-----	-----	-----	875,637
Duluth Board of Trade.....	15,645	-----	-----	1,076	-----	1,703	18,424
St. Louis Merchants Exchange.....	675	643	-----	-----	-----	-----	1,318
Milwaukee Grain and Stock Exchange.....	13,438	13,443	4,668	3,008	357	-----	34,914
Seattle Grain Exchange.....	3,567	-----	-----	-----	-----	-----	3,567
Portland Grain Exchange.....	1,411	-----	-----	-----	-----	-----	1,411
Hutchinson Board of Trade Association.....	404	-----	-----	-----	-----	-----	404
San Francisco Chamber of Commerce.....	-----	-----	-----	-----	428	-----	428
Los Angeles Grain Exchange.....	-----	-----	-----	-----	248	-----	248
Total.....	8,096,503	3,724,895	836,861	425,133	54,391	8,893	13,146,676
Percent of total trading done on Chicago Board of Trade.....	84.0	93.4	89.9	89.1	19.4	-----	86.9

TABLE 2.—*Average, maximum, and minimum daily volume of trading in each grain future and all futures combined on the Chicago Board of Trade during the fiscal year ended June 30, 1935, with dates of largest and smallest day's trading*

[In thousands of bushels; i. e., 000 omitted]

Grain	Average daily volume of trading	Largest volume of trading in single day		Smallest volume of trading in single day	
		Volume	Date	Volume	Date
Wheat.....	22,734	76,335	Aug. 9, 1934	5,265	Jan. 26, 1935
Corn.....	11,639	34,896	Do.	2,917	Do.
Oats.....	2,516	11,852	Aug. 10, 1934	344	Do.
Rye.....	1,267	6,470	Apr. 25, 1935	247	Mar. 9, 1935
Barley.....	35	480	Aug. 31, 1934	0	( <sup>1</sup> )
All grains.....	38,192	127,610	Aug. 9, 1934	8,815	Jan. 26, 1935

<sup>1</sup> Frequently.TABLE 3.—*Wheat futures: Monthly volume of trading on the contract markets, by markets, during the fiscal year ended June 30, 1935*

[In thousands of bushels; i. e., 000 omitted]

1934

Market	July	August	September	October	November	December
Chicago Board of Trade.....	921,720	1,068,254	500,287	651,878	515,119	461,773
Chicago Open Board of Trade.....	13,730	16,789	9,923	12,447	10,216	7,972
Minneapolis Chamber of Commerce.....	54,931	79,666	43,028	38,502	32,831	26,882
Kansas City Board of Trade.....	93,937	101,333	47,980	52,323	52,717	43,460
Duluth Board of Trade.....	2,793	3,060	2,236	1,262	1,350	847
St. Louis Merchants Exchange.....	-----	3	-----	-----	-----	5
Milwaukee Grain and Stock Exchange.....	1,613	2,467	1,199	1,417	1,216	937
Seattle Grain Exchange.....	403	638	203	203	503	188
Portland Grain Exchange.....	217	322	91	22	338	19
Hutchinson Board of Trade Association.....	16	59	52	41	33	40

1935

Market	January	February	March	April	May	June
Chicago Board of Trade.....	407,294	233,779	362,797	604,370	528,616	541,667
Chicago Open Board of Trade.....	10,323	6,349	9,646	10,679	10,537	9,418
Minneapolis Chamber of Commerce.....	23,521	14,632	23,024	46,818	37,298	36,268
Kansas City Board of Trade.....	36,366	24,169	35,788	68,365	59,667	62,394
Duluth Board of Trade.....	603	418	496	911	700	969
St. Louis Merchants Exchange.....	144	69	38	151	208	57
Milwaukee Grain and Stock Exchange.....	756	558	679	1,156	735	705
Seattle Grain Exchange.....	71	131	125	679	197	226
Portland Grain Exchange.....	18	13	17	256	81	17
Hutchinson Board of Trade Association.....	25	19	28	40	17	34



TABLE 4.—*Corn futures: Monthly volume of trading on the contract markets, by markets, during the fiscal year ended June 30, 1935*

(In thousands of bushels; i. e., 000 omitted)

1934

Market	July	August	September	October	November	December
Chicago Board of Trade.....	411, 761	555, 403	226, 226	276, 620	354, 459	310, 935
Chicago Open Board of Trade.....	3, 298	5, 246	2, 164	2, 410	2, 369	2, 691
Kansas City Board of Trade.....	23, 504	39, 001	13, 044	16, 190	20, 153	17, 003
Milwaukee Grain and Stock Exchange.....	1, 536	1, 973	1, 355	996	1, 185	1, 329
St. Louis Merchants Exchange.....						

1935

Market	January	February	March	April	May	June
Chicago Board of Trade.....	239, 638	150, 277	211, 342	311, 257	227, 150	204, 853
Chicago Open Board of Trade.....	2, 329	1, 766	2, 345	2, 741	3, 096	3, 175
Kansas City Board of Trade.....	11, 949	8, 738	13, 059	14, 663	9, 273	10, 681
Milwaukee Grain and Stock Exchange.....	1, 024	659	930	1, 001	717	738
St. Louis Merchants Exchange.....	101	79	116	181	111	55

## CLASSIFICATION OF FUTURES TRADERS

A survey was made by the Administration of the open commitments in wheat and corn futures on the Chicago Board of Trade as of the close of business September 29, 1934. The survey involved the examination of the records of more than 600 grain futures commission houses. It was found that on September 29 there were 13,194 accounts open in Chicago wheat futures and 8,089 accounts in Chicago corn futures, a total of 21,283 accounts, held by 18,385 traders, the difference between the number of accounts and number of traders representing the 2,898 traders holding accounts in both wheat and corn.

Eighty-eight percent, or 11,638, of the wheat-futures accounts and 89 percent, or 7,176, of the corn-futures accounts were speculative. Speculators held 75 and 74 percent of the long open commitments in wheat and corn, respectively, while, on the short side of the market, 82 and 79 percent, respectively, of the open interest in wheat and corn was held by hedgers. Ninety-two percent of the speculative long accounts in wheat were less than 25,000 bushels each, 48 percent being "job lots" (less than 5,000 bushels each). Similar percentages were found to prevail with respect to corn, 91 percent of the speculative long accounts falling below 25,000 bushels each, and 47 percent less than 5,000 bushels each. The individual hedging accounts in both wheat and corn were much larger than the individual speculative accounts. The 730 long accounts in wheat futures classified as hedges averaged 22,530 bushels each. The 299 hedging accounts on the short side of the market averaged 419,970 bushels each. In corn futures the 330 hedging accounts on the long side averaged 23,800 bushels each and the 345 short hedging accounts 200,700 bushels each. The largest speculative account in wheat futures amounted to 3,000,000 bushels long and the largest hedging account 10,630,000 bushels short.

Every State, the District of Columbia, the Philippine Islands, and 28 foreign countries were represented among holders of accounts. Traders residing in Chicago held 2,990 accounts, Iowa traders held 1,921 accounts, Illinois traders (exclusive of those residing in Chicago) held 1,743 accounts, and New York City traders held 1,170 accounts. Foreign accounts in both wheat and corn futures were predominantly long, foreign open commitments in wheat being 22,262,000 bushels long, as compared with 1,850,000 bushels short. In corn, foreign open commitments were 14,309,000 bushels long, as compared with 1,942,000 bushels short. China, with 344 accounts, ranked first with respect to number of foreign accounts and aggregate commitments, Canada being second with 326 accounts. Traders residing in China were 9,082,000 bushels long and 260,000 bushels short in wheat futures and 1,462,000 bushels long and 130,000 bushels short in corn futures. Canadian traders were 2,879,000 bushels long and 495,000 bushels short in wheat futures and 5,585,000 bushels long and 1,092,000 bushels short in corn futures.

Virtually every occupation was represented by holders of open commitments in wheat and corn, the list of vocations running alphabetically from abstractors to yeast makers, approximately 600 vocations and vocational divisions being enumerated. The largest single group represented was that of farmers, 1,492 having accounts in wheat and 1,047 in corn. Housewives ranked next to farmers with respect to the number of accounts held, 802 holding wheat accounts and 496 corn accounts.

### SMALL TRADERS SUPPORT HEDGING LOAD

Data compiled by the Administration disclosed that for the period from September 1934 to June 1935 the hedging load in the wheat futures market was carried almost entirely by the smaller traders having individual commitments in a Chicago wheat future of less than 200,000 bushels. A recent study indicates that during the final quarter of the year just ended more than 50 percent of the open short commitments and from 7 to 12 percent of the open long commitments in wheat futures on the Chicago Board of Trade were held by 40 to 50 persons, firms, and corporations located in Chicago, New York, Kansas City, Minneapolis, Duluth, and Omaha. These traders were divided about equally between speculators and hedgers, the latter holding the greater portion of the short commitments, most of the long commitments being held by speculators.

### JOB-LOT TRADING

An analysis of data procured from the clearing house of the Chicago Board of Trade, covering the 6-month period, January to June 1935, relative to the proportion of the volume of trading in grain futures on the board of trade in round lots (units of 5,000 bushels and multiples thereof) and the proportion in job lots (amounts less than 5,000 bushels) disclosed that 11.08 percent of the trading in wheat futures and 13.34 percent of the trading in corn futures was in job lots; for oats and rye the respective percentages of job-lot trading were 11.86 and 6.99. Analytical study disclosed that there is a close relationship between volume of trading in round lots and in job lots, this relationship being expressed mathematically by the correlation coefficient  $+0.94$  for Chicago wheat futures and  $+0.90$  for Chicago corn futures (a perfect correlation being represented by  $+1.00$ ).

### LITIGATION

The Commission created by the Grain Futures Act (consisting of the Secretary of Agriculture, chairman; the Secretary of Commerce; and the Attorney General) issued its opinion, findings, and order during the year just closed in the case of *Secretary of Agriculture v. Adrian Ettinger and Ewing W. Brand*, members of the Chicago Board of Trade, and Ettinger & Brand, copartnership. The complaint alleged that the respondents had violated the Grain Futures Act in failing to keep records and in concealing from the Administration the facts concerning transactions in grain futures on the Chicago Board of Trade in May, June, and July 1933; that the respondents rendered false reports and gave names of fictitious persons as being parties to transactions which at one time involved an aggregate open interest in Chicago wheat futures of nearly 20 million bushels. The Commission, although finding that the Grain Futures Act "was clearly violated" as charged in the complaint filed by the Secretary of Agriculture, announced that certain mitigating circumstances set forth by the respondents had been taken into consideration, that denying the respondents contract market privileges for an indefinite period or for a long period did not seem warranted, and ordered that all contract markets refuse all trading privileges thereon to the respondents for a 6-month period commencing December 1, 1934.

Proceedings before the Commission pursuant to the complaint filed by the Secretary of Agriculture under the Grain Futures Act against Arthur W. Cutten, member of the Chicago Board of Trade, on April 9, 1934, were concluded during the year. The complaint alleged that the respondent, described by Government counsel before the Commission as "perhaps the greatest grain speculator this country ever knew", had violated the act and rules and regulations pursuant thereto in concealing his transactions and open commitments in Chicago wheat futures, in failing to make reports to the Administration, in making allegedly false reports, and allegedly conspiring with grain futures commission merchants to conceal his operations on their books through false, fictitious, and dummy accounts. It was charged in the complaint that the respondent had failed to report to the Administration on 149 days during 1930 and on 170 days during 1931, on each of which days he was required to report by the law and regulations. The complaint also alleged that the respondent's maximum short position in wheat futures in 1930 was 7,525,000 bushels and that his maximum short position in 1931 was 6,770,000 bushels, none of which was reported to the Administration. The complaint alleged further that in 1930, during the time the respondent had open commitments that he was allegedly concealing, he was short 79 percent of the time, and that in 1931 during the period that he had an open net position concealed, he was short 89 percent of the time. He was short on 493 of the 562 days during the 2-year period upon which he had an open position.



Following a hearing before a referee designated by the Secretary of Agriculture, under the Grain Futures Act, filing of briefs by the Government and the respondent, and oral argument before the Commission, the Commission found that respondent Cutten had transacted his grain futures commission business through eight commission firms, dividing his trades into 35 accounts, some of which were carried in the names of relatives and associates, but all of which were owned or controlled by the respondent; that during 1930 the respondent made no reports to the Administration; that during 1931 he made reports irregularly, "none of which was true or correct as a statement of his net position on the market on the day covered by such report"; and that during 1931 he made false reports of his open commitments and transactions in accounts "definitely identified as his and indisputably belonging to him, contrary to the act and regulations made pursuant thereto." The Commission found further that the respondent's purpose in concealing his position in the market—

was to manipulate the price of grain and thereby to make large profits. He systematically allocated purchases and sales of wheat futures to the various accounts in order to keep them under 500,000 bushels, and thus to avoid detection. He attempted to manipulate the price of grain.

Under date of February 12, 1935, the Commission ordered that all contract markets refuse all trading privileges thereon to respondent Cutten for a 2-year period commencing March 1, 1935. The respondent appealed from the order of the Commission to the United States Circuit Court of Appeals for the Seventh Circuit, the appeal serving to postpone the effective date of the denial of trading privileges, the court in granting the appeal announcing, however, that should the appeal be finally dismissed the 2-year period of denial should commence as of the date of the dismissal of the appeal or from such other date thereafter as the court might direct.

During the year a complaint was filed by the Secretary of Agriculture under the Grain Futures Act against Thomas M. Howell, member of the Chicago Board of Trade, charging that respondent Howell manipulated the price of corn and corn futures in July 1931. The complaint alleged that the respondent individually and through associates purchased cash corn and July corn futures during the summer of 1931 and withheld from sale practically all such purchases to the end of the delivery month for the purpose of manipulating the price of corn in violation of the Grain Futures Act. It was charged that the holdings of July corn futures by the Howell group increased from 32 percent of the total open contracts on May 26, 1931, to 85 percent on July 30; that by July 18 the group held warehouse receipts for all the corn in Chicago deliverable on Chicago Board of Trade contracts; and that on the last 3 days of the delivery month, as the result of the concentration of contract corn in the hands of Howell and his associates, cash corn and July corn futures advanced approximately 14 cents a bushel, thereby penalizing those who had sold corn for July delivery. This abnormal price increase lasted but 3 days and was of negligible benefit to producers, few of whom were in position to get their corn into Chicago to be sold at the artificial price.

Hearing upon the complaint of the Secretary of Agriculture was held before a referee, at which time the respondent admitted for the purpose of the proceeding that he alone was responsible for and had sole control over each and every transaction in cash corn and July futures in each of the 17 different accounts involved which were scattered among 8 commission houses, with the exception of 1 account held by a friend. The Commission on August 16, 1935, issued its opinion, findings of fact, and order. The Commission found that the respondent controlled each of the 17 accounts, and found further, in part, as follows:

By controlling the greater part of the open interest in 1931 July corn futures and withholding it from sale, respondent cornered the market in that future. \* \* \* Respondent's conduct in cornering the market in 1931 July corn futures, and in manipulating the price of corn and corn futures, was intentional. Respondent thus attempted to manipulate and did manipulate the price of corn as charged in the complaint.

The Commission ordered that all contract markets refuse all trading privileges thereon to the respondent for a 2-year period commencing September 15, 1935. The respondent, on August 29, appealed from the order of the Commission to the United States Circuit Court of Appeals for the Seventh Circuit, the appeal serving as a stay of the Commission's order.

### OPEN COMMITMENTS

During the year the Administration continued its daily announcement of the amount of open commitments in each grain future on the books of clearing members of the principal contract markets. The amount of open commitments in each major corn and wheat future on the Chicago Board of Trade, at semimonthly intervals, during the year is shown in tables 5 and 6, respectively.

TABLE 5.—*Wheat futures: Open commitments in each major future on the Chicago Board of Trade, shown semimonthly, for the period June 30, 1934, to June 29, 1935*<sup>1</sup>

[In thousands of bushels; i. e., 000 omitted]

Date	Future				All wheat futures
	July	Septem- ber	Decem- ber	May	
1934					
June 30.....	9,636	84,061	23,300	-----	116,997
July 14.....	2,751	84,578	51,041	-----	138,370
July 31.....	-----	65,937	84,747	7,590	158,274
Aug. 15.....	-----	29,575	98,583	34,842	163,000
Aug. 31.....	-----	10,845	97,798	49,162	157,805
Sept. 15.....	-----	3,795	84,321	65,124	153,240
Sept. 29.....	130	-----	73,545	73,000	146,675
Oct. 15.....	3,201	-----	59,164	72,284	134,649
Oct. 31.....	6,297	-----	47,973	78,992	133,262
Nov. 15.....	8,812	-----	36,594	88,240	133,446
Nov. 30.....	14,186	-----	14,202	99,183	127,571
Dec. 15.....	17,923	-----	2,367	104,525	124,815
Dec. 31.....	19,961	-----	-----	99,327	119,288
1935					
Jan. 15.....	20,717	1,682	-----	88,890	111,304
Jan. 31.....	21,104	2,586	-----	81,560	105,250
Feb. 15.....	20,966	3,431	-----	74,691	99,088
Feb. 28.....	22,191	4,985	-----	69,123	96,299
Mar. 15.....	22,495	6,921	-----	62,156	91,572
Mar. 30.....	23,261	8,673	-----	52,511	84,445
Apr. 15.....	28,816	13,375	-----	39,125	81,316
Apr. 30.....	34,629	20,988	-----	17,417	73,034
May 15.....	40,153	26,391	700	2,992	70,236
May 31.....	38,436	28,526	5,938	-----	72,900
June 15.....	30,334	31,675	12,384	-----	74,393
June 29.....	12,520	40,958	17,708	-----	71,186

<sup>1</sup> The maximum open commitments in all wheat futures were 165,864,000 bushels on Aug. 9, 1934. The minimum open commitments were 69,275,000 bushels on May 18, 1935.

TABLE 6.—*Corn futures: Open commitments in each major future on the Chicago Board of Trade, shown semimonthly, for the period June 30, 1934, to June 29, 1935*<sup>1</sup>

[In thousands of bushels; i. e., 000 omitted]

Date	Future				All corn futures
	July	Septem- ber	Decem- ber	May	
1934					
June 30.....	6,364	46,175	8,878	-----	61,417
July 14.....	1,145	48,568	13,114	-----	62,827
July 31.....	-----	44,992	38,156	-----	83,148
Aug. 15.....	-----	24,672	52,978	11,415	89,065
Aug. 31.....	-----	8,270	59,831	19,103	87,204
Sept. 15.....	-----	2,717	58,648	23,955	85,320
Sept. 29.....	-----	-----	56,528	27,510	84,038
Oct. 15.....	1,700	-----	49,872	31,693	83,265
Oct. 31.....	2,681	-----	42,158	36,633	81,472
Nov. 15.....	7,660	-----	27,517	47,268	82,445
Nov. 30.....	13,777	-----	11,215	50,777	75,769
Dec. 15.....	17,347	-----	4,844	48,680	70,881
Dec. 31.....	18,658	-----	-----	52,058	70,726
1935					
Jan. 15.....	19,636	2,064	-----	45,631	67,346
Jan. 31.....	19,139	2,836	-----	42,162	64,152
Feb. 15.....	19,686	3,547	-----	41,445	64,693
Feb. 28.....	20,160	4,091	-----	38,295	62,561
Mar. 15.....	18,992	5,474	-----	33,337	57,813
Mar. 30.....	17,677	7,442	-----	31,508	56,627
Apr. 15.....	18,746	10,350	-----	26,389	55,485
Apr. 30.....	18,991	11,842	10	13,597	44,440
May 15.....	17,951	12,222	147	8,968	39,288
May 31.....	19,793	13,090	2,551	-----	35,434
June 15.....	17,044	14,584	4,761	-----	36,389
June 29.....	11,946	16,698	8,112	-----	36,756

<sup>1</sup> The maximum open commitments in all corn futures were 90,392,000 bushels on Aug. 11, 1934. The minimum open commitments were 35,434,000 bushels on May 31, 1935.



## DELIVERIES ON FUTURES CONTRACTS

The volume of trading during the life of each major grain future on the Chicago Board of Trade expiring during the year just ended, the maximum open commitments therein, the amount of open commitments at the beginning of the respective delivery months, the volume of contracts fulfilled by the delivery of grain, their percentage of the total sales, and the total quantity of actual grain delivered on such contracts are shown in table 7.

TABLE 7.—Volume of trading (sales) during the life of each principal grain future on the Chicago Board of Trade expiring during the fiscal year ended June 30, 1935, maximum open commitments in each future, open commitments in each future at beginning of delivery month, futures contracts settled by delivery of grain, and total quantity of actual grain delivered

[In thousands of bushels; i. e., 000 omitted]

Future	Volume of trading during life of future (sales)	Maximum open commitments during life of future	Open commitments at beginning of delivery month	Futures contracts settled by delivery		Total quantity of actual grain delivered
				Volume	Percentage of total sales	
Wheat:						
1934 July.....	1,455,908	48,074	9,636	3,792	0.26	1,151
1934 September.....	1,793,104	89,090	10,845	6,043	.34	3,227
1934 December.....	1,878,248	99,540	14,202	9,298	.50	1,484
1935 May.....	2,322,665	105,698	17,417	11,987	.52	2,044
Corn:						
1934 July.....	435,519	46,308	6,364	4,429	1.02	1,151
1934 September.....	701,318	51,784	8,270	4,770	.68	2,272
1934 December.....	978,251	61,878	11,215	1,890	.19	1,136
1935 May.....	1,297,068	52,058	13,597	4,109	.32	2,182
Oats:						
1934 July.....	174,181	19,769	3,853	1,796	1.03	280
1934 September.....	298,893	27,780	3,095	1,035	.35	269
1934 December.....	215,929	22,300	4,375	1,127	.52	555
1935 May.....	294,815	27,601	6,064	3,025	1.03	1,001
Rye:						
1934 July.....	57,584	7,174	2,668	1,202	2.09	836
1934 September.....	81,227	11,143	4,027	4,818	5.93	2,786
1934 December.....	95,584	10,218	3,067	1,488	1.56	1,004
1935 May.....	146,104	16,463	4,354	3,467	2.37	1,287
Barley:						
1934 July.....	5,032	972	412	404	8.03	296
1934 September.....	6,970	1,215	159	75	1.08	42
1934 December.....	5,177	795	350	297	5.74	299
1935 May.....	1,887	278	147	86	4.56	86

## PENDING LEGISLATION

A bill to amend the Grain Futures Act in the light of the Administration's 12 years' experience in administering the act was passed by the House of Representatives on June 3, 1935, and was pending in the Senate upon the adjournment of the first session of the Seventy-fourth Congress. The pending bill would authorize the Commission created by the Grain Futures Act to establish limitations on the speculative transactions of individual operators in grain futures and in cotton, mill feed, butter, egg, and rice futures for the purpose of diminishing or eliminating the burden of excessive speculation. Hedging transactions would be expressively exempted from trading limitations. Futures commission merchants and floor brokers executing futures transactions, under the terms of the pending bill, would be required to register annually with the Secretary of Agriculture, registration being subject to suspension or revocation for cause. Margins deposited with futures commission merchants by traders in the futures markets, under the provisions of the bill, would be required to be treated as the property of the customers for whom deposited, the use of such margins to extend the credit or to margin the trades of others being strictly prohibited. Certain practices which, the Administration has found, lend themselves to the cheating of customers or the manipulation of grain prices, such as puts and calls, wash sales, cross trades, and the bucketing of customers' orders, would be outlawed under the proposed amendments, as would the operation of bucket shops. Additional protection

would be afforded cooperative associations of producers, their admission to membership and commodity exchange privileges, pursuant to the order of the Commission, being expressly preserved pending appeal of any order of the Commission to the United States Circuit Court of Appeals. The pending measure seeks to preserve the benefits of the existing future trading facilities and to eliminate or drastically curb the evils flowing from the abuse of these facilities. Its enactment into law to supplement and reenforce the Grain Futures Act should result in substantial benefit to all using the futures exchanges for legitimate economic purposes.









## REPORT OF THE CHIEF OF THE BUREAU OF HOME ECONOMICS, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF HOME ECONOMICS,  
*Washington, D. C., August 31, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I present you herewith the report of the Bureau of Home Economics for the fiscal year ended June 30, 1935.

LOUISE STANLEY, *Chief.*

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The fundamental principle that consumption is the end and purpose of production has been reemphasized during the past 2 years and, as a consequence, the consumers' stake in public policy has been stressed. This point of view has given additional significance to the work of the Bureau of Home Economics. Not only has the importance of studies of consumption been emphasized, but the relation of these studies to national planning has gained wider recognition. If production is to meet consumer needs, the studies of this Bureau are basic in showing what should be produced, the qualities demanded in the commodities and the materials developed from them, and the amounts necessary to supply consumer needs. While in the past consumer use has been a check on production, planned production, based on consumer need, and forecasts of probable consumer demand are now suggested as providing a closer fit between production and consumption, with greater return to producers and greater satisfaction to consumers.

The basic purpose of the Bureau's program is to raise national levels of living by encouraging more effective consumption. The Bureau helps individuals and families to improve their consumption practices, in some cases having direct contacts, as through providing research findings and other material to educational and welfare agencies. It also furnishes information concerning consumers and the consumption value of goods and services for producers to use in planning their production programs to more nearly meet consumers' needs and preferences, and for governmental and other agencies to use in formulating social policies relating to consumption.

In order to supply the basic data for estimating probable consumer requirements, considerable time has been spent during the past year in planning a large scale study of consumer expenditures at different income levels. To coordinate the plans for the consumption studies of this Bureau with plans of other Government agencies, the chief of our Economics Division has been assigned for the past 3 months to the Central Statistical Board to work with a coordinating committee of the National Resources Committee. The plans for a consumption study have been worked out in some detail so as to furnish a comprehensive picture of the current requirements of the consumers of this country. This study has been proposed as a Works Progress Administration project.

But this is not enough. Insofar as consumer requirements can be measured in terms of desirability, it is important to think of the production of goods needed as well as those demanded. Studies are made by the subject-matter Divisions of the Bureau—Foods, Clothing and Textiles, and Household Equipment—to determine the qualities in ultimate-consumer goods contributing the most to consumer satisfaction. The Economics Division shows how the goods

and services available can be combined best to meet the needs of families of varying composition and income.

In the field of food commodities, considerable headway has been made in this. Nutrition studies of the Bureau have been directed to show by diet patterns how families of various sizes should select their food to meet, at different cost levels, current food habits and the demands for good nutrition. During the past year adaptations of these patterns have been worked out for use where particular food crops are especially abundant.

Such food plans are necessarily drawn in broad, general lines. The detail must be filled in with many small special studies, which, however, take on a new significance when viewed as a part of the whole. The importance of small things in nutrition—such as vitamins and traces of mineral elements—makes much detailed research necessary and ties the human-nutrition studies in rather closely with the scientific studies of the various production bureaus.

Composition of food varies with the soil and other cultural conditions. Certain soils produce foods toxic to animals and also to humans. In some areas the soil conditions are such that foods grown there are deficient in specific mineral elements, as for example, copper and iron, essential for hemoglobin formation, with the result that a high percentage of anemia is found in the children fed too exclusively on foods grown in these areas. Although problems such as these would probably yield to fertilizer treatment, food-composition studies help to show where such treatment is necessary, and by cooperative effort the condition can be corrected with considerable advantage to public health.

If economic planning is to help forward a more abundant life, it is of first importance to know the essentials for good living. Basic to life itself is health. Physiologists, nutritionists, and clinicians are showing the close relation between the kind of food we eat and health. In planning food production the United States Department of Agriculture, while mainly concerned with production plans which will be economically most profitable to the farmers, has a still greater responsibility for the protection of national health. It is important that food production be planned with the requirements of national health in mind.

## FOODS AND NUTRITION

For convenience the research work on foods and nutrition is organized in three sections: (1) Food composition, summarizing available information on chemical constituents of different foods; (2) nutrition studies, with special reference to the presence and significance of vitamins and minerals in human nutrition; and (3) food utilization, studying the quality and uses of foods and the influence of conditions of production upon the quality.

### FOOD COMPOSITION

Interest in the nutritive value of various food crops has been much heightened by the economic situation and by actual and proposed changes in the use of the land. The Food Composition Section of the Bureau has been able to make an important contribution to the subject through a large fund of information on the chemical composition of foods that has been accumulated from many authentic sources. This compilation has enabled us to supply information on food values to many agencies and individuals that are faced with food-selection problems or with problems of producing or processing foods.

On careful examination of the findings thus brought together it has become evident that available data are inadequate to show the influence of soils and soil treatment on the mineral content of foods. Since this influence of soils is a matter of first importance to agriculture, the need for further analytical work, under a unified plan, has been brought to the attention of various laboratories that are equipped to cooperate. Several of these have initiated new studies, at our instigation, and some have already sent in partial reports on completed portions of the work. The Bureau of Home Economics serves as a coordinating agency and is making plans to extend this cooperative project.

Two studies have been conducted in cooperation with the American Dietetic Association. The first, a system of grouping fruits and vegetables according to their carbohydrate content, which had been prepared in tentative form, has been perfected and published after further trial in hospital practice had shown it to be adaptable and satisfactory. It is being widely used, since it



provides a uniform system of classification and one which reduces errors in computing diabetic and other special diets.

The second study, undertaken to meet the further demand of hospitals and social agencies, will attempt to provide a more satisfactory means of estimating the composition of cooked meats as served in hospital or home diets. Cooked meats are being judged and analyzed chemically to test the validity of a proposed scheme of classification for this particular purpose. The preliminary analyses made by the Food Utilization Section indicate that satisfactory results can be expected but show the need for a modification of the first draft of the plan. Accordingly, hospital laboratories that are taking part in the study will make the necessary adjustments as their work continues, reporting progress periodically.

### NUTRITION STUDIES

Research in our nutrition laboratories is directed especially to the vitamin and mineral content of foods and the physiological effects of those food substances on the human body. Present-day knowledge of vitamins is far from complete, particularly as to the relative value of different foods known to contain them. During the past year the Nutrition Section has been engaged in translating into quantitative units the vitamin data already available and summarized. This material is being prepared for printing. Meanwhile a digest of it has been mimeographed for the use of dietitians and others interested in diet planning.

In the course of making this compilation it became evident that there was wide variation among authorities as to the vitamin C content of oranges and tomatoes. At the same time an unusual prevalence of scurvy among young children was reported from several large cities. As the citrus fruits and tomatoes are considered the best antiscorbutic foods, particularly for children, experiments were at once undertaken in our laboratories to recheck the current findings as to the relative vitamin C values of orange juice and tomato juice. The study will continue over a period of at least a year in order that different varieties may be studied, as well as the effects of different conditions of production and different methods of canning and storing on the vitamin C content of these juices.

In cooperation with the Bureau of Plant Industry this Bureau has studied the vitamin A content of tomatoes of different colors. The yellow variety contained slightly more than 1 Sherman unit and slightly less than 1 international unit of vitamin A per gram. The Red Marglobe (yellow skin) showed somewhat more than 8 Sherman units and approximately 8 international units per gram. The Gulf State Market variety (transparent skin) was considerably richer in vitamin A than any other variety, assaying almost 16 Sherman units per gram. Practically no vitamin A was found in the white tomato studied.

During the last 4 years a project has been under way to determine the vitamin A content of a yellow-fleshed potato. This variety, known as "Golden", was obtained by the Bureau of Plant Industry from a series of crosses between yellow-fleshed and white varieties in an effort to obtain a potato of high vitamin A content. This potato was compared with samples of the white Green Mountain and Irish Cobbler, an unnamed yellow-flesh seedling resulting from a cross of a yellow with a white variety, and a yellow potato similar to the original potato used in deriving the Golden. The original yellow potato, steamed, assayed about 100 units of vitamin A per 100 grams of fresh material. The white potatoes and the unnamed yellow seedling gave something over 20 units per 100 grams, while Golden was the poorest of the lot, assaying approximately 20 units per 100 grams.

Escarole has been credited with a vitamin A content so far above any other green vegetable for which data were available that a check was made in our laboratory. Tests of green outer leaves indicated 100 Sherman units of vitamin A per gram and about 125 international units. This value is about one-half that previously reported. The green outer portion of the leaf, i. e., that part left after the stem was removed, assayed about 150 Sherman units per gram.

The vitamin A rating of canned salmon of different species and also their content of vitamins D and G were checked in our laboratory in response to requests from relief workers, to whom large quantities of canned salmon were consigned. The vitamin A content was found to vary in the different species. Of these samples, red salmon was richest in vitamin A, Chinook was next, then pink, and lastly chum. Two brands of each species were tested, and the

samples were prepared by draining off the liquid and removing the skin and bones. Canned salmon is a valuable source of vitamin D and contains considerable amounts of vitamin G.

Tests are under way to determine the vitamin content of three kinds of nuts—almonds, filberts, and walnuts. In order to comply with demands for emergency work, our important spectrographic study of trace minerals in natural foods was interrupted during the past year. It will be resumed with a study of the mineral content of eggs. We expect to establish a list of trace elements normally present in eggs and follow through any that may prove of significance in human nutrition.

#### FOOD UTILIZATION

A series of studies of cooking quality and palatability in foods as affected by conditions and methods of production has been in progress in the Food Utilization Section for several years. Meats of different kinds and several varieties of potato have been used in these experiments, and the leavening power of eggs has been studied to show its relation, if any, to the diet of the hens, their laying cycle, and the season of the year. Other work has included experiments to show how cooking technic influences the appearance, food value, and palatability of the product, and also the fuel requirements.

Much of the work in this Section was done in cooperation with the Bureaus of Animal Industry and Plant Industry, and also, where meat was concerned, with the Bureau of Agricultural Economics and State experiment stations. Meat-canning problems arising in relief canning centers were studied also, and jelly-making experiments were continued with a variety of fruit juices.

#### EGGS

The egg studies indicate that the diet of the hen has little, if any, effect upon the properties which give eggs the leavening power that is depended upon in such dishes as omelets, soufflés, sponge cake, etc. Nor does it appear from our experiments that this quality varies with the laying cycle of the hen or the season of the year. Fifty samples of eggs from hens receiving five different rations were studied from the beginning through 9 months of the laying cycle and during the fall, winter, spring, and part of the summer seasons. The studies included measurements of the hydrogen-ion concentration, total solids, carbon dioxide, refractive index, and viscosity of the eggs, and specific volume, compressibility, and tensile strength of sponge cakes made from the different samples of eggs.

#### MEAT

For the meat studies about 350 cuts of meat from experimental animals were cooked to determine their palatability as affected by the feed, sex, and age of the animals and the curing and storing methods used.

In the experiments with pork, the hogs were fed rations which differed in source but not in the proportion of protein. In one ration the protein was supplied by fresh skim milk, in another by dried skim milk, and in a third by tankage. In general, the meat from the hogs fed the fresh-milk ration was superior in palatability to that from the hogs fed the dried skim milk and the tankage rations. Differences were small, but the trend was consistent for the factors of tenderness, intensity and desirability of flavor of lean, desirability of flavor of fat, and richness of juice. The results are believed to justify further work to establish more definitely the possibilities of fresh skim milk in the production of high-quality pork.

In a comparison of meat from hogs which received a submaintenance ration of corn silage and clover hay and meat from hogs full-fed on a good ration, loins and half hams were tested. The meat from underfed hogs was found to be less desirable, both when it was judged as usual and when the judges were blindfolded. From the psychological angle, it was interesting to find that in studies on flavor detection less difference was detected between the desirability of meat from full-fed and that from underfed hogs when the judges tasted the meat without seeing it.

As part of the studies of lamb and mutton cured and stored for varying lengths of time, loins, legs weighing up to 6 pounds, and legs weighing more



than 6 pounds were cooked for palatability tests. On the whole, the results indicate that with the methods employed it is impracticable to store the cured loins, and that cured legs can be stored successfully for a short time, but that heavyweight legs were more palatable than lightweight legs. The fat of cured lamb and mutton, however, soon became rancid, presenting serious problems and confirming previous work.

In a series of experiments to show how cooking technic influences appearance, shrinkage, and palatability of meat and the fuel requirements of the oven and speed of cooking, comparisons were made between constant-oven-temperature roasting and methods which include an initial sear and a slow finish. The cuts used were standing and rolled ribs of beef cooked to the rare, medium, and well-done stages. These experiments round out a study on beef similar to that reported in Technical Bulletin 440, entitled "Shrinkage and Heat Penetration During the Roasting of Lamb and Mutton as Influenced by Carcass Grade, Ripening Period, and Cooking Method."

For the guidance of the housewife in preparing the leaner meat which was then found on the market in larger proportion than usual as a result of the drought, a pamphlet, Miscellaneous Publication 216, *Meat Dishes at Low Cost*, was prepared. This pamphlet gives the principles of cooking meat according to tenderness and fatness and includes 60 recipes for braised steaks and chops; pot roasts and stews; low-priced roasts; ground meat, sausage, and salt pork; left overs and canned meat; liver and other edible organs.

Because of the many requests for the exhibit entitled "What Temperature Roasting", shown at A Century of Progress in Chicago in 1933, enlarged photographs of the three beef roasts have been made. These photographs, mounted, with a brief description of the experiment, are available for loan to teachers and research workers.

#### POTATOES

The studies on potato quality were expanded to include two new investigations, the variation in cooking quality of one variety of potato within one field and the effect of maturity of potatoes on their cooking quality. About 30 seedling potatoes were tested for palatability for the purpose of determining varietal selection.

Several methods, including soaking in warm water and different solutions of sodium and calcium chloride and dextrin solutions, were used to free potato slices from the excess sugar found in the potato during storage at low temperatures. While several methods were successful in removing the sugar, other undesirable effects, such as blistering, poor flavor, and increase in oiliness offset the improvement in color. Reduction of the sugar in the potatoes by storing at high temperature for a short time was found to be the most desirable method of improving the color of the potato chip.

#### SOYBEANS

To demonstrate the palatability of soybeans as a green vegetable and to select varieties according to environment for production, 77 varieties of soybeans produced by the Bureau of Plant Industry were tested in our experimental kitchens. On the basis mainly of flavor rather than texture, about 20 percent of the varieties were rated excellent, 46 average, the remainder poor.

The quality of soybean milk derived from different varieties of soybeans and made by different methods was also studied in cooperation with the Bureau of Plant Industry. Of the common varieties of soybeans, Rokusun, Haberlandt, and Mammoth Yellow were found to be the most desirable for milk, and it was demonstrated that the soybean milk could be used in any recipes calling for milk. The mash left from making the milk had very little flavor, but it could be used in combination with food of more pronounced flavors to make loaves, soufflés, stuffings for vegetables, sandwich fillings, and to increase the volume and food value of simple cakes and quick breads.

By fermentation or by adding acid, a curd can be produced from the milk, and used in salads or rarebits and for sauces for rice, macaroni, hard-cooked or scrambled eggs, and other foods.

#### FATS

Study of the keeping and cooking qualities of different kinds of fat, begun 2 years ago, was continued. Chemical tests of 3 kettle-rendered and 1 prime

steam lard, 2 hydrogenated vegetable fats, and 3 vegetable oils made at intervals of 6 months during 1½ years of storage showed very little change in free fatty acid content and no marked increase in peroxide value. The samples were stored in containers of different type and size, in order to determine the effect, if any, of this factor on keeping quality.

After a year's storage, tests were made to determine the deterioration of odor and flavor. Among the hydrogenated fats no extreme differences were apparent. While approximately half of the samples had a moderately undesirable odor, none of the others scored lower than neutral or moderately desirable. The hydrogenated fats showed the most consistent high score, both for large and for small packages. The 3 kettle-rendered lards, the prime steam lard, and the corn and peanut oils showed the greatest deterioration.

At the end of a year and a half, the fats were used as shortening in biscuits and judged for taste and odor. Two of the kettle-rendered lards made from fat of hogs fed respectively on a peanut and a corn ration were most frequently marked by judges as stale or rancid. Cottonseed oil also scored low in flavor. The prime steam lard ranked among the best. The corn oil gave the most desirable flavor although the peroxide value was the highest of all the fats.

#### CANNING

Experience gained in the large-scale canning of drought-relief meats in 1934 makes it necessary to change our recommendations for the processing of home-canned meats. At the beginning of the emergency the processes used in relief canning were those then in common use. The canning was done under varied conditions of weather, sanitation, equipment, and with many inexperienced workers. It soon appeared, however, that heavier processes would be necessary to reduce spoilage. Laboratory tests showed that even the heavier processes do not always give actual sterilization, but they do destroy the botulinus bacteria, which might cause food poisoning, and other still more heat-resistant organisms which would be probable causes of spoilage under average conditions of storage.

To study the effect of the heavier processes on the quality of the canned meat, paired leg muscles from prime beef were canned by the heavy and the shorter processes. It was found that there was very little difference in the quality of the two products. Further studies are being made in which samples will be stored 6 to 8 months.

Since no regular laboratory inspection service was available for the examination of the meat products packed from drought-relief animals in Federal and State canning plants, samples of these products were sent in for examination. Over 500 cans of meat were examined for flavor, trim, color, odor, and tenderness. The meat was rated on the average as fair in quality, and wholesome, although lacking the finer flavor and tenderness found in meat canned from animals of good grade.

The number of community canning centers in operation over the country has increased during the past 2 years until there are now several thousand. In the smaller centers there has been much need for information on the handling of canning equipment. For this reason the mimeographed circular, Community Canning Centers, has been revised and enlarged with more detailed information on canning equipment and the process of canning in tin cans.

#### JELLY MAKING

Study of the jelly-making qualities of some of the more common fruits was continued for the fourth season. Work with blackberries, raspberries, crab apples, currants, grapes, and quinces gives additional evidence of variations in the fruits which influence their jelling properties. Measurements which show these variations are the specific gravity, viscosity, and acidity of the fruit juices and the gel strength of the jellies.

The fruit of an ornamental tree, *Dillenia indica*, grown in Puerto Rico, was tested as a possible source of commercial pectin. The fruit was found to contain very little—only 0.5 percent—of acid-extractable pectin. Storage studies showed that a temperature of 50° F. with 70 percent humidity, brought about very little change in the fruit over a period of 30 days.



## TEXTILES AND CLOTHING

While the relation of clothing to health is not so direct as that of food, the expenditures for clothing and household textiles come next to food in many families, and the selection and care of these commodities are an important economic consideration to all consumers. Our Textile and Clothing Division studies the composition of textile fabrics with a view to setting up guides for the consumer in wise choice and use.

This Division has also made studies to show the relation between the grades of cotton and wool fibers and the consumer-use value of the fabrics made from these fibers and from these fibers mixed with others. These studies are important in adapting fiber production to consumer need and probable demand, as well as in evaluating the influence of production factors on quality as interpreted in consumer terms.

Economic conditions during the past few years have focussed particular attention upon consumer problems. Choices in the case of textiles and clothing are especially difficult because of the lack of buying guides such as grades, standards, or consumer specifications to help the ultimate consumer select these products intelligently. It is widely recognized that before a buyer can identify the true qualities of textile materials and thereby determine the one best suited to his needs, he must be supplied with definite information regarding the construction or performance in use of the articles from which he must make a selection. Otherwise he is completely at the mercy of the seller. His buying must be a haphazard, "by guess" method. This is also true of much of the buying of institutions that do not have testing laboratories at their disposal. It has been an outstanding difficulty of relief agencies attempting during the past few years to purchase clothing which would represent the best value at relief cost levels.

A second deterrent to intelligent selection and use of textiles is the lack of information as to the relative value of different raw fibers when put into goods for consumer use. At the present time no one knows the durability and desirability from other standpoints of different grades and varieties of fibers when woven into fabrics. No information is available on the effect of conditions of fiber growth and development upon the wearing qualities of finished materials.

The scarcity of data on the effect of various cleaning agents and cleaning processes on different textiles, especially those of recently developed synthetic fibers and finishes, is often another direct cause of loss of money to consumers. The garment made unwearable by laundering or dry cleaning is a common occurrence in many households and a significant drain on family resources.

These difficulties have an important bearing on the textile production of the country. It is impossible to build an intelligent agricultural program as far as textile production is concerned so long as there is no information available regarding the relative usefulness and probable demand for different varieties, grades, and kinds of fiber in consumer use. It is impossible to plan intelligently in the absence of basic scientific information regarding the serviceability and hygienic and other values of different materials and fabric constructions. In this time of great competition of one fiber with another, these matters take on added significance.

### FABRIC COMPOSITION

In order to determine the characteristics of the merchandise from which consumers must now make a selection on the retail market, this Division is making physical and chemical analyses of representative qualities of staple textile articles. For example, 37 pairs of cotton Turkish towels, typical of the choice available to consumers during the spring and summer of 1934, were analyzed and the results published. Such physical properties as weave, type of yarn, yarn twist per inch, thread count, breaking strength, bursting strength, thickness, and water absorption were determined. The chemical condition of the cellulose was investigated by means of determinations of hydrogen-ion concentration, methylene blue absorption, fluidity in cuprammonium hydroxide, and copper-number tests.

In general all the towels tested could be classified in four groups or construction types according to thread count and ply of yarn. Type 1 might

include those towels having a single-ply ground warp with half as many ground as pile ends; type 2, those also having single-ply ground warps but an equal number of ground and pile yarns; type 3, those having two-ply ground warps with half as many ground as pile ends; and type 4, those having two-ply ground warps equal to the pile yarns in number. The physical properties tended to group into these classifications, as follows:

Type 1 towels were considerably weaker than any of the others, for bursting as well as breaking strengths. Those having two-ply ground warps and more yarns per inch were stronger, but the rate of water absorption was slower. For example, when the values were averaged for the four types of construction, the water absorption of type 4 was found to be lower than that of the other three. In this connection it should be noted, however, that rate of absorption as measured by the method used does not take into account the total water held. Type 4 would no doubt be high in total water absorbed.

Additional towels are being analyzed, and the study will be continued until sufficient data are available for the setting up of quality grading systems or other types of consumer buying guides.

A similar study was made of 44 representative household and camp blankets purchased during the spring and fall of 1934. These were analyzed for weave, type, and kind of yarn, thread count, yarn twist per inch, breaking strength, fiber composition, weight, thickness, heat transmission, air permeability, fiber-length distribution, fineness of fiber, bursting strength, and resistance to abrasion. The results showed that there is a very wide variation in the physical properties of blankets now on the market and emphasized the need of informative labels giving facts which could be used by purchasers as buying guides. For example, some blankets were 12 times as strong as others, a few having a tensile strength fillingwise of less than 3 pounds (strip method).

The bursting strength ranged from 29 pounds for one all-cotton blanket to 142 pounds for an all-wool one. Warmth also varied widely. In general, the thicker the blanket the warmer, but there was no direct correlation between thickness and warmth. The all-wool blankets weighed from 8.4 to 14.9 ounces per square yard, the wool-and-cotton ones from 6.9 to 14.7, and the all-cotton from 4.6 to 11.1 ounces. All other factors being equal, the lightest weight blanket would be the most desirable. However, reducing the weight may also reduce the warmth and durability. In the blankets tested, the all-wool ones showed either a low filling breaking strength or a high heat transmission and a high air permeability for those with weights below 13 ounces per square yard.

No one blanket analyzed was consistently high or low in all properties. As far as indicated by this study, it is necessary for a purchaser to select blankets that have one outstanding quality such as warmth or light weight and still meet certain minimum requirements in other properties such as thickness and tensile strength.

#### SERVICE TESTS OF TEXTILE FABRICS

At present practically no studies have been made to show the relation of construction and composition of textile materials to serviceability. It is therefore impossible to advise consumers as to what serviceability can be expected from a fabric of a given construction or composition. The Bureau has made a beginning on this type of study. For example, serviceability tests on Turkish towels of different constructions are now under way. Work of this kind has also been coordinated with other research dealing with the serviceability in consumer use of various kinds and grades of fibers in which the Department is interested from a production standpoint.

A service study on blankets made from various combinations of fine, one-half blood, three-eighths blood, one-fourth blood, and reworked wool has been made in cooperation with the Bureau of Animal Industry. This is almost completed, and the results are being prepared for publication. The effect of wear and laundering on these blankets has been compared with that of laundering alone. The resistance to bacterial action of the different kinds of blankets when new and after different periods of wear has been studied with the aid of a buffered trypsin solution and the progressive deterioration with service recorded by photomicrographs of the treated fibers. Although service produced no measurable change in the cystine content of the wool, the sulphur content was found to decrease slightly. The oxygen-bomb method for determining sulphur was compared with the Benedict-Denis method, and found to give more accurate results. None of the blankets contained sulphate sulphur.



Another group of blankets composed of three-eighths-blood wool, reworked wool, and mohair have been woven, and their serviceability is also being determined. A study of the comparative use-value of sheetings made of cottons grown under irrigated and nonirrigated conditions is nearing completion.

#### BUYING GUIDES FOR CLOTHING AND HOUSEHOLD TEXTILES

The material on clothing and household textiles, which is available, is being compiled in a series of buying-guide leaflets. This now includes the titles: "Quality Guides in Buying Ready-made Dresses," "Buying Guides for Costume Slips," "Buying Bedspreads," "Quality Guides in Buying Household Blankets," and "Quality Guides in Buying Sheets and Pillowcases."

#### CARE OF HOUSEHOLD TEXTILES

Studies relating to the household care of textiles have been restricted this year to an investigation of the effect of ironing upon sheeting fabrics composed of known cottons. A paper reporting the chemical and physical changes in such fabrics produced by applied ironing pressures has been prepared for publication. In general an increase in temperature was found to be more damaging than the same percentage increase in pressure.

At both high and low pressures first changes in color, as measured by surface reflectance, occurred at least 130 Fahrenheit degrees lower than first changes in breaking strength. Reflectance curves for fabrics from Good Middling, Middling, and Strict Good Ordinary cottons tend to be almost identical with increasing deterioration of the ironed cotton. An increase in pressure from 1 to 4 pounds per square inch with a household ironer of the roll type produced a measureable stretching of fabrics in the direction of motion. Since no corresponding shrinkage at right angles to the motion was obtained, a more open weave would be developed with repeated ironings at high pressures, which would obviously reduce the resistance of the material to wear and laundering. This effect on the fabric was not noted for the same pressure change when there was merely still contact with the heated metal.

Experimental results showed the resiliency of a padding to be very essential. The nature of the padding exerted much more influence at low pressures than at high. When a hard, unyielding material was used at pressures from 1 to 1½ pounds per square inch, damage was increased as much as 50 percent of the value obtained with normal padding.

Data on the effect of time of contact with an ironing surface are being prepared for publication. The period of contact for most of these observations varied in range from 1 to 60 seconds. At a temperature as low as 220° F. and a pressure of 1¼ pounds per square inch, a contact of 12 minutes produced only slight indications of scorch.

In the course of the ironing studies it has been found that damaged samples showing only a small change in breaking strength were very much weaker after a laundering process. Used cotton fabrics which had been washed 175 times in water containing only a moderate degree of hardness gave much less change in color with ironing if they were previously given a treatment with sodium meta- and pyro-phosphates. Since this treatment removed lime and magnesium soap, it is probable that continued inadequacy of rinsing is responsible for relatively large color changes previously observed for used materials.

The mimeographed circular, *Home Dyeing With Natural Dyes*, has been in such great demand that further study was made on this subject. Various methods of mordanting and additional dye materials were investigated. More exact recipes than had hitherto been published were developed. The results of this work have been reported in a manuscript accepted for printing in the *Miscellaneous Publication series of the Department*.

A series of seven charts showing the use of natural dyes in handicraft work has been made. These are lent for use in extension and other classes interested in craft work.

#### CLOTHING DESIGNS

In addition to the projects on the purchasing of clothing, most of the work of the Division on clothing construction and design has been related to the emergency situation. However, the four traveling exhibits of recommended designs and materials for infants', creeping babies', and preschool children's clothes have continued to be used all over the country. In addition to the

purpose for which they were originally planned, they are now proving valuable as standards of construction. This aspect of clothing education is being stressed by supervisors of relief rooms and by home economists in an effort to teach value in ready-made clothes as well as in those made in the home. Mimeographed circulars illustrating and describing new playsuit designs for both summer and winter have been issued.

To supplement the two traveling exhibits of clothes made from used materials, ways have been worked out for using materials and cast-off articles of apparel that have heretofore not been considered usable. These exhibits have proved particularly useful in self-help and emergency sewing schools and relief workrooms all over the country.

## HOUSING AND EQUIPMENT STUDIES

Government housing projects now under way have increased the demands upon the Bureau for advice in house planning from the standpoint of the housekeeper. Kitchen arrangements in particular, and tests of such large pieces of equipment as stoves and refrigerators, are the concern of one section of the staff. This work, carried on in the interest of efficient operation of the household with the greatest convenience to the housekeeper, is intended to furnish guides to the architect or builder of the house and to the manufacturer of household equipment, as well as to the purchaser.

To test the adequacy and convenience of kitchens planned for rural housing, and to illustrate the principles of convenient arrangement for different types of kitchens, a method has been developed of building models of kitchens, completely equipped, in miniature. This has in some cases shown up faults in the architect's plans, and has proved a useful and economical way of checking those plans. It also offers illustrative material for educational and publicity purposes.

In connection with this study of kitchen arrangement, work has also been done in cooperation with the Department of Interior in standardizing the equipment and planning the arrangement of kitchens for different-sized families for slum-clearance projects under the Public Works Administration.

This work demonstrated the importance of establishing standards of convenience and adequacy for the kitchen and its equipment. For economy in building costs, as well as convenience of the housekeeper, such standards should be applied by the architect in drawing the original plans.

In general, the tests of electric stoves showed that enclosed speed units are more desirable for surface-heating elements than the open units. They are faster than open units, some of them taking only half the time required by open units of the same wattage. Because of their greater efficiency, they consume only from two-thirds to three-fourths as much energy as the open units. While the initial cost of the enclosed units is more, this greater speed, lower cost of operating, and their much longer life indicate greater economy in the long run.

For greater efficiency and economy in the use of electric stoves, however, there is need of more attention to the designing, as well as selection, of cooking utensils especially adapted for use on electric heating elements.

The laboratory tests of electric ovens show wide variations in temperature in different parts of the same oven at the same time, and a wide variation in the energy and time consumed by the different ovens in the preheating of the oven and the baking processes. For example, one oven with top and bottom heating elements took less time and less energy in preheating through a range of temperatures from 200° to 600° F., and in baking, than an oven which had only one heating element. The first one also produced more satisfactory baking. This is markedly influenced by the type and amount of insulation.

As compared with electric ranges, small separate pieces of electrical cooking equipment proved more efficient and economical for low-cost housing in rural sections. But tests of some of the very cheap hot plates on the market today show them to be unsafe, and their life to be very short, due to the inferior quality of the connections and the wires used. Standards should be set up to keep them off the market.

A study of the low-cost mechanical refrigerators on the market shows that under laboratory-test conditions at 90° F., such cabinets with good insulation can maintain satisfactory internal temperatures with current cost of less than 2 kilowatt-hours a day. The tendency is to build the larger models better, and poor construction of some of the small cabinets makes them a poor buy. As



electric refrigerators are now made, current consumption varies little with cabinet size to 6- or 7-cubic-foot food space. It therefore seems better to buy a box of 6 cubic feet or more, if the family purse and the space available for the cabinet will permit.

Our studies also indicate that under test conditions at 90° F. room temperature, a good refrigerator of about 6-cubic-foot food space uses per month about 50 kilowatt-hours of electrical energy, 900 pounds of ice, 12 gallons of kerosene, or 1,800 cubic feet of gas. The test conditions used are such that the mechanical refrigerators maintain an average temperature of 43° F. The ice refrigerators give an average temperature of 53° F. Because of difference in design, both the mechanical and the ice-cooled refrigerators give about 46° F. in the space intended for milk. At lower room temperatures all these values will of course be lower.

### ECONOMIC STUDIES

What consumers buy, what proportion of their income they spend for different classes of goods and services, and how adequate those purchases may be for health, comfort, and satisfaction—these questions, considering the fact that the household unit is the chief consumer buyer, are the main concern of the Economics Division. Its studies are intended to give consumers help in improving their standards of consumption, to develop concrete plans for money disbursement, use of time, and resources other than money, so as to promote the consumption standards established and afford a basis for advising consumers as to market selection of goods and services.

In meeting these objectives, the Economics Division has for several years past proceeded along three lines with main emphasis on the first: (1) Studies of the consumption habits and needs of American families, including an appraisal of the economy and nutritional adequacy of diets; (2) the economics of consumer buying; and (3) studies of time spent in household tasks.

#### CONSUMPTION HABITS AND NEEDS OF FAMILIES

A study of economic and social problems and conditions of the southern Appalachians, in which a number of interested State and Federal agencies have participated cooperatively over a period of 4 years, has included research by this Division on the consumption habits of families of this mountain area. The purpose of the study was to provide a basis for a well-rounded plan of social action to effect increased well-being of the region's people. To the report, published as Miscellaneous Publication 205, *Economic and Social Problems and Conditions of the Southern Appalachians*, this Division made two contributions—a description of the content of living of these farm families and the variations in the different neighborhoods, and an appraisal of their diets.

Findings from the Division's study are of especial interest now when a national program of rural rehabilitation and resettlement is under way. They indicate clearly how badly located land of low fertility may contribute to low living levels throughout large areas. Investigators found that among the Appalachian farm families studied, those who were living comfortably were in fertile areas where good roads, schools, and health services helped to increase their well-being. Most of the families, however, lived under unsatisfactory conditions, due in part to the low productivity of their small farms, which are sloping and have poor soil. Lack of access to markets and limited opportunities for employment by means of which they might supplement their meager returns from farming also are factors leading to low family incomes. In an unproductive farming area where poverty is widespread, it is impossible for the area alone to provide schools, libraries, health units, roads, and other goods and services by means of which general living levels may be raised.

Many of the families studied lacked the training and information needed to help them make the best possible use of what resources they had. The formal education of the homemakers and farm operators was too limited to help them improve the consumption patterns and ways of farming followed by previous generations. Poor roads limit their contacts and thus help to keep them unaware of developments which have increased well-being elsewhere, such as advances in the technics of homemaking, in medicine, and in education. Large families have tended to lower the level of living. The Division's study emphasizes the importance of outside earnings by family members to supplement farm income in areas such as this which are not well adapted to agricul-

ture. Families of the highest level of living were found to have the largest income from nonagricultural sources.

The Division's extensive investigation of 228 of these southern Appalachian families in Knott County, Ky., furnishes an even better picture of living content than do the two sections of the joint publication, just described. A report, almost ready for press, depicts in detail the ways of living of a group of low-income, rural families whose farms yield little more than is needed for home consumption, annual average sales of farm products being only \$55 per family. Outside earnings averaging \$337 per family supplemented their small incomes. Common to the county were these characteristics: early marriages; numerous children; small frame houses, often overcrowded; lack of toilet facilities, especially at the lowest living levels; absence of modern conveniences, only 4 of the 228 families having water piped to a bathroom and only 25 having electric lights; isolation, only 1.4 percent having autos and the same percentage radios; and low standards of education.

Intensive study of the food consumption of 41 of these Knott County families indicated that many diets could have been made more adequate had the families been more aware of the importance of certain foods for health and had farm production been planned to supply those foods.

Although the low consumption levels prevalent in this mountain county were due in part to geographic location and other factors beyond the control of the individual family, this study indicates that a wisely planned and well-executed educational program could do much to increase family well-being. Cooperating educational agencies plan to make such use of the research report. But its value is not limited to that section alone. Data concerning the living content and money expenditures of these low-income farm families have served as a basis in this Division for the preparation of budgets and other material to be used by educational and welfare agencies working with rural-rehabilitation families in other localities.

Such a broad cooperative research study indicates, too, the need for a comprehensive social program if family well-being is to be achieved. No one agency can solve the problem alone. Thus home-economics education would have to be supplemented by such other social action as special educational programs planned by farm-management specialists to help the farmers make the best possible use of their resources, extension of roads to remote localities, and broad policies in regard to use of land.

The publication, *Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method*, is now in press as Miscellaneous Publication No. 223. This is the first comprehensive bibliography of such studies. In addition to a brief description of the type of information available in each report listed, the authors discuss techniques used in gathering and analyzing data on family living. The publication should, therefore, assist in pointing the way to better research on family consumption in the future. It will also be of service to educators and other workers concerned with family well-being, since it will help them to find source material concerning the family living of groups comparable to those with which they work.

Plans have been made for a Nation-wide study of family consumption to be undertaken with other governmental agencies, if funds are available, and the Division has given the time of its members who have been asked to advise with other groups interested in research on national consumption.

An account book is an important tool for improving consumption, since it helps a family to appraise its past ways of spending and to plan so that future expenditures may better serve its needs. This Division, therefore, has long been interested in family accounts, has published a family account book, and has cooperated with extension workers in a Nation-wide study of the forms best adapted for account keeping. This past year, with the cooperation of the home-management specialist of the Federal Extension Service, the Division has issued a simple, rotaprinted farm-home account book, designed especially for use by extension agents helping rural-rehabilitation families.

Since the demand for this book has indicated wide-spread interest in account keeping, it is planned to replace it by a printed farm-household account book better adapted to serve all types of farm families. Recognizing the importance of using such a book in conjunction with a farm account book, help of specialists from the Bureau of Agricultural Economics and the Agricultural Adjustment Administration has been sought in planning the net-worth sheet and other forms to be included. Similar books for the city family and for the individual are being prepared.



The need of families for help in their budgeting problems has been evident in Division correspondence. Families of all income levels, but especially those with reduced incomes, have written for aid in planning budgets so that their money may give them the greatest returns. In meeting these requests, the Division has stressed the importance of obtaining the best possible diet at the lowest possible cost, and has furnished food budgets, menu plans, guides for food buying and, in cooperation with the Food Utilization Section, economical recipes. Suggestions designed to help extension workers plan suitable budgets for rural-rehabilitation families have been set up in tentative form. Budgets have been prepared for specific low-income groups at the request of other Government agencies interested in finding out what levels of living are possible with given incomes.

#### ECONOMICS OF CONSUMER BUYING

The growing recognition of the importance of consumer buying problems has been reflected in correspondence. The Division has been called on by teachers for help in their consumer-education programs and by housewives wishing to become better buyers. In addition, one member of the Division had a part in the preparation of a bulletin on consumer education for issuance by the Office of Education. So popular has been Miscellaneous Publication 193, *Present Guides for Household Buying*, that the supply has been exhausted, and this Division has cooperated with the Division of Textiles and Clothing in its revision. It also has contributed to the work of other governmental agencies working with consumers' problems.

















## REPORT OF THE DIRECTOR OF INFORMATION, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF INFORMATION,  
Washington, D. C., September 1, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the informational work of the Department of Agriculture for the fiscal year ended June 30, 1935.

Sincerely yours,

M. S. EISENHOWER, *Director.*

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### NEW TRENDS IN INFORMATION

Several important trends marked the informational work of the Department during the past year.

As a result of progress made by a number of the interbureau committees created to formulate basic programs of research and service, it became possible to plan the dissemination of useful information more systematically and effectively.

This Office placed greater emphasis on information needed in efforts to plan the use of natural resources.

It also strove to keep the publishing, press, and radio programs responsive to the immediate needs of farmers and other groups.

There was increased regionalization and localization of information, thus making useful information available in more satisfactory form to those who could apply it.

### ORGANIZING INFORMATION

The need for a better correlation of the Department's information resources is of long standing. The Department is organized functionally, and necessarily so, for research and service. Divisions of each of six bureaus deal, for example, with problems affecting cotton. It has been necessary for the information staff to gather facts from all the bureaus concerned, and, in cooperation with the bureaus, to determine the points needing special emphasis. This sometimes resulted in a slighting of certain phases of work, and in the overemphasis of other phases, or in a failure to make currently available the information likely to be most valuable.

The problem of correlating information has now been simplified somewhat by a number of developments, among them the following:

*Coordinated cotton program.*—Several months ago, an interbureau cotton committee prepared a report on past, present, and needed research on cotton. This report definitely outlined a program of research and service which will help in the improvement of the cotton industry. The Office of Information can use the report as a basis for better planned information work. Now, instead of emphasizing first one and then another recommendation, perhaps disproportionately, it is possible to keep all the requirements in view, and to relate each press release, publication, or radio talk to the whole problem.

*Genetics committee.*—A committee on plant and animal breeding is surveying an important field that is basic to agricultural progress. Its conclusions will

afford a guide and provide perspective to information forces in making available existing information on principles of breeding and on the location of superior forms of plant and animal life already developed.

*Land-use committee.*—A Department land-use committee is coordinating all land policies and programs in the Department and is providing a clearer idea of problems and objectives in land planning.

*Soil Conservation Service.*—One of the important objectives of the Department of Agriculture is the conservation of the soil. Prior to the establishment in this Department, during the past year, of the Soil Conservation Service, soil-erosion-control activities were divided among several bureaus—in fact, among several departments. The centralization in a single agency of the activities relating directly to erosion control has removed many difficulties in shaping up practical information on how to check soil losses.

#### COMMODITY WRITERS

As the information available in the Department becomes correlated along the lines of commodities and major problems, the machinery for disseminating it should be similarly molded.

Formerly, the Office of Information tended to function along bureau lines. A single writer might be assigned to cover several bureaus. He could not have a specialized knowledge of all of the work covered. He could not keep in contact with all the activities of the several bureaus, and could not keep abreast of the current needs of 6,000,000 farm families for information coming from the bureaus he covered.

On some of the major commodities, writers should be in a position to specialize, so as to meet the information requirements of producers, consumers, processors, and handlers. The Radio Service has begun to work in this manner, and a wider application of the principle is desirable.

#### REGIONALIZATION OF INFORMATION

The problem is to send out to the people in each section information that they need in conducting their farm and home work. We cannot render such service to the individual farm family, but we should make an effort to supply generally adapted information to the families of each agricultural region.

Many popular bulletins have been regionalized. Press releases are issued specifically for different sections of the country. Often such releases are limited to a State or group of States. Also, press releases are frequently limited to interested groups by sending them to certain specialized or trade publications—an effective and inexpensive method of “regionalizing.” Perhaps the most rapid progress recently has been made in radio work. Five years ago the Department, in cooperation with the agricultural colleges in the Western States, inaugurated radio broadcasts to serve the far Western States more effectively. During the past year a plan was put into effect to split the western network into two sections on certain days to deal with the special problems of different sections of the Western States.

A similar, and more far-reaching, development has taken place in the syndicate radio service. We now send the Farm Flash syndicate material to 35 State extension services to be adapted to, and supplemented with, information for the various sections of each of these States; we have broken the original five major regions for which we prepared specially adapted information into 11 regions, with still further refinements of regions for material of restricted application. Gradually we are evolving, in cooperation with State extension executives and local agents, a system of making information fit the needs of the audience of the cooperating station and having it presented by a local authority on agricultural subject matter—the county agricultural agent. Thus basic information growing out of the Department's research is being adapted more closely to the requirements of the public who will benefit by applying it on their farms and in their homes.

The possibility of achieving a still greater degree of regionalization in informational work appears in the present plans of the Department and affiliated agencies to regionalize agricultural research, planning, and administration.

#### COOPERATION WITH T. V. A.

The Tennessee Valley program is a significant attempt at planned regional development. With the appointment early in 1935 of a coordinator to represent



the Department of Agriculture, the Tennessee Valley Authority, and the agricultural colleges in the seven States in the Tennessee Valley, it seemed to the Office of Information that a good opportunity had arisen to demonstrate (1) the effectiveness with which a branch of a permanent Government department, cooperating on a voluntary basis with a coordinating agency (the T. V. A.), can participate in a dynamic regional-planning program; and (2) how far the Department, in close cooperation with the colleges, can go toward meeting more fully the needs for agricultural and home economic information for the people of one region of the country.

As a first step, this Office took an inventory of all Federal and State publications giving information useful to farmers and homemakers of the Tennessee Valley area. We are now preparing a reference list of this material for the guidance of T. V. A. workers and the farmers and homemakers of the area. Such a list will also guide the preparation of needed additional publications bearing on the problems of the region.

We expect to explore the possibilities of cooperation between the Department and various States in the preparation of publications, in improving and simplifying the system of distributing publications, and in serving more completely and effectively through radio and press the needs of the area for agricultural and home economic information.

### TRENDS IN CHARACTER OF INFORMATION

In my report last year I emphasized that farmers and the general public are turning to the Department more than ever before for help and accurate information. Inquiries coming to the Department touch upon all phases of agriculture, but those pertaining to conservation, farm adjustments, subsistence farming, and general farm-management problems predominate. The widespread interest in economic information and information related to current planning activities—manifest through correspondence and in a host of other ways—has been reflected in the type of information issued during the past year. The following information activities of the year are indicative of trends:

*Discussion groups.*—In connection with the Department's efforts to encourage public discussion of major problems affecting agriculture, a number of model discussion group programs were presented on the Farm and Home Hour. These broadcasts dealt with such problems as foreign trade, production adjustment, rural-urban balance, and taxation. They were received favorably by radio listeners. More than a thousand listeners wrote to the Department asking for suggestions on establishing rural discussion groups. It seems to me significant that rural people are beginning to participate in group discussion of strictly unbiased factual information, together with pro and con interpretations of such information, as a basis for making key decisions affecting the future welfare of agriculture and the Nation.

*Economic information.*—Millions of farm families are participating in, or are affected by, current programs of agricultural adjustment, soil conservation, resettlement, and so on. They have occasion from time to time to make decisions as to basic policies to be followed in national programs, as to their individual relationships to various programs, and as to adjustments to make in their individual farming activities. Their interest in economic information about agriculture continues to increase. This Office has, therefore, cooperated with the Bureau of Agricultural Economics in releasing an increasing amount of information dealing with all aspects of the economic situation, and discussing in some detail such factors as carry-over supplies, export demand, foreign and domestic tariffs, foreign and domestic production, and farm prices and income.

*Planning information.*—For many years the Department has been compiling basic information about the agricultural resources and problems of the Nation. It has been surveying and classifying the soils, making inventories of forest resources, studying population movements and problems, and mapping plans for conserving wildlife resources. With the present impetus to planning and conservation activities, the Department often has been taxed to supply technical as well as general information bearing on these activities. The more significant information developments along this line included the completion of the soils section of the Atlas of American Agriculture, the only document of its kind in the country; a series of broadcasts on the findings and recommendations of the National Resources Committee; a series of press releases by States reporting

the results of a soil-erosion reconnaissance survey; a series of press releases by States reporting the results of the rural tax-delinquency survey conducted by the Bureau of Agricultural Economics with Federal relief funds; a comprehensive Bibliography on Land Settlement; a comprehensive report on Economic and Social Problems and Conditions of the Southern Appalachians; and a publication entitled "A Program of Waterfowl Restoration."

*Research information.*—Every program of the Department is predicated on research. The agency which attempts to map out a reforestation, soil-conservation, wildlife, or even regulatory program must have basic information from the research men of the Department.

The farmer, too, is more dependent on research than ever before. If he intends to plant land retired from commercial crops to forage crops he must have suitable, adapted crop varieties and information about the production and utilization of such crops. Farmers who encounter new, serious outbreaks of insects and disease must look for protection to the findings of science. Research is more and more essential to regulatory and service work. The need for research has been reflected in an increased appropriation for scientific work under the Bankhead-Jones Act. As research work increases in volume and importance, means should be developed to present its results more quickly and effectively.

A rather general practice of most research institutions has been to give, in press releases, the mere bald announcements of the results of research; for example, to report the development of a new insecticide and how to apply it, without telling how it was developed in the laboratory, how commercial producers became interested, and why it is effective. Such details have been reserved, as a rule, for scientific journals of limited circulation. This office has found that there is active interest in popular explanations of the scientific principles underlying research, in interpretations as clear and simple as words can make them.

A conspicuous example of the kind of writing required to explain intricate scientific principles in language which laymen can understand appeared this year in the *Farmers' Bulletin* entitled, "The What and How of Hybrid Corn", by F. D. Richey, Chief of the Bureau of Plant Industry.

There is no better way to indicate to laymen the real significance of the results of scientific research than to take them behind the scenes, to interest them in the principles involved, to reveal interesting angles and tangles, to record some of the failures as well as the triumphs.

Many of our reports through the press have included explanations of principles underlying notable researches, interesting incidents and mechanisms, laboratory methods, and the like. Editors and writers have made good use of such material. A news release in April told how "a clue provided by an insect" led entomologists to discover allantoin which provides "a new way to heal stubborn wounds quickly." Others interpreted new ideas in plant nutrition and recent discoveries that nitrogen, phosphorus, and potash do not make full rations for plants which also must have small quantities—sometimes almost inconceivably small quantities—of boron, manganese, zinc, and copper if they are to thrive.

Still others interpreted some of the intricacies of genetics and why plant explorers now bring back plants that an earlier generation would have scorned, plants that are not promising in themselves but have one or more desirable factors—disease resistance, hardiness, drought resistance—to breed into related crop plants. We have explained phases of photoperiodism by which plant breeders are sometimes able to restrict or add to the length of the light period in a greenhouse and so force plants to bloom in off seasons and so make possible the crossing of species which could never occur naturally. Hope wheat (a cross with emmer), according to one article, is valuable, not because it is a good market wheat, but because it has the one invaluable genetic quality of resistance to rust which may be bred into other superior market varieties.

News stories carried readers to the borderland where life begins with the sunlight working in partnership with the green coloring matter in leaves to manufacture the elementary substances on which all plant and animal life depend. We have tried to help readers visualize the teeming billions of lower organisms in a spoonful of fertile soil and to understand how science is just beginning to distinguish between helpful and harmful organisms. Readers have had glimpses of scientists on a hurry-up job of fighting a plant disease or an insect plague, creating artificial droughts, freezes, and epidemics to test new varieties of plants to determine their value.



In a new series of broadcasts devoted to research, we told the story of the investigations back of the shelterbelt project in the Midwest, and endeavored to correct some of the prevalent misconceptions. We outlined the investigational work and practical experience underlying the control method (the eradication of snails) for the destructive malady known as "liver flukes" of livestock to promote a better understanding of what otherwise might be regarded as freakish control measures. We related the story of Dr. Cushing's discovery of the second variety of screwworm fly (*Cochliomyia americana*) to make clear to the livestock owner why the Department revised some of its earlier recommendations on screwworm control. We outlined the work leading up to the discovery of allantoin. This broadcast was the only one for which there was any particular incentive for listeners to write to the Department. Within a week, this broadcast brought requests from 300 physicians and a host of laymen for further information.

The scientists' growing recognition of the value of prompt, general dissemination of the results of research in suitable form is reflected in a resolution adopted by the Twelfth International Veterinary Congress, which met in the United States last year. The resolution says in part:

Be it resolved: That The 12th International Veterinary Congress hereby embody in its deliberations a broad recognition of the importance of prompt announcement and wide distribution of significant results of sound research. That the nations provide adequate facilities, personnel, and funds for perfecting present methods of disseminating knowledge, thereby facilitating early and broad use of such knowledge, aiding research, and preventing duplication of effort.

#### EXPENDITURES

In the foregoing, I have attempted merely to give the highlights of some of the more significant trends in information work. In the succeeding sections on the Division of Publications, the Press Service, and the Radio Service are further details on the operations of this Office.

The printing charges for the Department for the fiscal year 1935 amounted to \$671,212. The original appropriation was \$610,466; a 10-percent increase in the appropriation was authorized, under section 21, E, of the act of March 28, 1934, to cover the increased costs of printing, and \$300 was transferred to the Treasury Department.

Charges for salaries and expenses totaled \$343,583. The original appropriation totaled \$323,641; the difference between charges and appropriation was made up through the transfer to this Office of unexpended funds from the Bureau of Animal Industry, and through funds appropriated for salary restorations under section 21, E, of the act of March 28, 1934, and under section 2, D, of the act of February 13, 1935.

#### DIVISION OF PUBLICATIONS

The Division of Publications, along with its usual job of editing, printing, and distributing all Department publications, continued to play an important part in providing useful information to those who need and request it. An examination of the list of bulletins issued during the past year (pp. 9 to 11) shows many publications that have important bearing on such present needs of agriculture as the prevention of soil and wind erosion, the back-to-grass movement, the control of plant and animal diseases and pests, the conservation of natural resources, and the solutions of economic problems affecting agriculture and rural life.

Among the more significant publications of general social value issued during the past year were:

*General planning.*—Economic and Social Problems and Conditions of the Southern Appalachians, A Method of Rural Land Classification, A Program of Waterfowl Restoration, Bibliography on Land Settlement with Particular Reference to Small Holdings and Subsistence Homesteads.

*Erosion control.*—Soil Blowing and Dust Storms, Effect of Cover on Surface Run-Off and Erosion in the Loessial Uplands of Mississippi, Methods of Reestablishing Buffalo Grass on Cultivated Land in the Great Plains, The Physical and Chemical Characteristics of the Soils from the Erosion Experiment Stations.

*Grass and forage.*—Manual of the Grasses of the United States, along with publications on specific forage crops such as bur-clover, vetch, crested wheat-grass, and red clover.

*Forestry.*—The Forest-Tax Problem: Causes of Decadence in Old Groves in North Dakota; Forest Improvement Measures for the Southern Appalachians; Poplars, Principal Tree Willows, and Walnuts of the Rocky Mountain Region.

Other significant publications included Farmhouse Plans, The What and How of Hybrid Corn, The Direct Marketing of Hogs, Cotton Production in Egypt, and Agriculture in Southern Africa.

All told, 18 Farmers' Bulletins, 8 Leaflets, 26 Miscellaneous Publications, 43 Circulars, and 54 Technical Bulletins were issued during the year.

The number of manuscripts sent to the Government Printing Office increased 20 percent over the number sent the preceding year, and the free distribution of publications increased 21 percent.

#### FREEDOM OF SCIENTIFIC EXPRESSION

During the year great pressure was brought upon the Department to force the discontinuance of two publications that discuss diets for families of different income levels. The plain purpose of these bulletins is to enable families to get the best possible nutrition for the amount of money they can afford to spend. Naturally the groups of foods making up the emergency diet are considerably different from those making up the liberal diet. The liberal diet contains much more fresh fruit, fresh vegetables, milk, and meat, and less of certain other commodities. The charge was widely publicized that the Department of Agriculture was advocating reduced consumption of certain commodities. The contention was unfounded because if the American public followed the suggestions contained in the Department publications there would be an actual increase in consumption. But more important was the fact that the Department's freedom to issue unbiased information developed by scientific research was in danger.

Fortunately, Members of Congress looked carefully into the whole matter and upheld the Department's position. It is clearly evident that if the Department of Agriculture could not discuss balanced rations and diets, as well as the component parts of such rations and diets, it could not aid livestock and dairy producers to improve their feeding practices; nor could it aid pellagra victims in the South, who must change their dietary practices if they are to overcome this disease; nor could it aid consumers generally to achieve more healthful diets for given expenditures. Above all, it must be remembered that the permanent value of this Department depends upon its ability to pass on to the public all the knowledge developed by its studies, regardless of whether such knowledge may injure temporarily a few minority groups, or whether such knowledge is of immediate value to everyone.

#### INCREASE IN SUBJECT-MATTER REQUESTS

The percentage of inquiries which require the preparation of special replies has increased greatly in recent years. During normal times a large percentage of inquiries may be for general information on such subjects as hog production, or cholera, or alfalfa. Comprehensive publications on such standard topics give full particulars of such problems. But, with thousands of new families on farms, or interested in moving to farms, and with established farmers materially reshaping their plans, the inquiries take on a decidedly different character. A letter may ask for special compilations of statistics, for the economic bases of programs, about locating a desirable type of farm in a particular section of the country, about procedure in obtaining loans, about the production of poultry and vegetable crops, or about supplementing a cash income with home production of fruits and vegetables. A great many of these requests are from families in straitened circumstances, who are about to, and must, make important changes and need intelligent guidance promptly.

At present, clerks in the correspondence unit refer all subject-matter inquiries to bureaus of this Department, and to other agencies. The relaying of the inquiry to various offices often results in delay. Scientists and administrators carrying on important projects are forced to devote considerable time to handling correspondence, much of which could be handled just as well by someone with a thorough, but more generalized knowledge; under present conditions, after a delay of a few days to several weeks, the inquirer may get possibly 2, or 3, or 4 letters from representatives of various agencies.



I think the Department should consider the possibility of forming a staff of persons with a well-rounded agricultural background who can prepare authoritative replies to a large percentage of the inquiries in the subject-matter category. I believe such a plan would provide much better service for the public and result in economies within the Department.

#### **PURCHASE OF SEPARATES FROM OUTSIDE JOURNALS**

A new feature during the year was the authorization by law for the purchase of reprints from outside journals. The amount of information accumulated by the Department as a result of its research work and the demands made upon it for the dissemination of its information have been so vast that the Department's limited printing funds have not been adequate to issue all this material. Hence, for years the various bureaus of the Department have had a great many of their articles printed in outside journals. Not until the fiscal year 1935 did the Department have authority to use part of its printing and binding fund for the purchase of separates of those articles that were deemed necessary for the official use of the bureaus in answering correspondence and otherwise disseminating the information. Approval was accordingly given for the purchase of separates of 117 articles, 14,095 copies of which were ordered at an estimated cost of \$911.97.

#### **STATISTICAL ITEMS**

The detailed records of the work done by the various sections of the Division are placed on file in this Office; the following is a brief summary:

The number of jobs of photographic work done totaled 220,113, and those of drafting work 2,506, a considerable increase over the number in 1934: 3,876 printing requisitions were drawn for various types of printing for the Department proper and 2,171 requisitions were drawn for printing for the Agricultural Adjustment Administration; \$2,726.10 was received in 17,654 letters asking for publications; 6,522 visitors received 35,315 copies of publications; 510,950 letters were handled in the Distribution Section.

For sending 197,386 copies of publications abroad in exchange for those received from all parts of the world, \$5,683.88 was required for postage; an increase of 26 percent occurred in the amount of duplicating work done during the year, as compared with that for 1934, the total number of pages thus produced amounting to 111,167,608, 52 percent of which was for the Agricultural Adjustment Administration.

#### **RECORD OF MANUSCRIPTS**

On July 1, 1934, the Division of Publications had on hand 121 manuscripts of publications. During the year, 1,286 additional manuscripts were received. Of that number 16 were disapproved for publication and 8 were withdrawn. Editorial preparation was completed on 811 manuscripts, 23 were retained in the Printing Section until new appropriations became available July 1, 1935, and 1,229 were sent to the Government Printing Office. On June 30, 1935, 131 manuscripts were on hand.

#### **DISTRIBUTION OF PUBLICATIONS**

The total free distribution of Department publications, given in detail in table 1, was practically the same in 1935 as in 1933. The increase for this year was accordingly almost identical with the decrease for 1934—2,662,461 copies, exclusive of Farmers' Bulletin lists and copies of the Monthly List of Publications—a 21-percent increase. This resulted from the opportunity to loosen up somewhat on the rigid restrictions that had previously been imposed on free distribution, and was in harmony with the demand for the publications. Much of the increased distribution was made from bulletins on hand.

The Superintendent of Documents received \$49,767 from the sale of Department bulletins and periodicals.

TABLE 1.—*Report of publications received and distributed by the Office of Information, from July 1, 1934, to June 30, 1935*

Item	Copies on hand July 1, 1934	Copies of new publications received	Copies of reprints or revisions received	Total copies available for distribution during year	Copies distributed during year	Copies on hand June 30, 1935
Agricultural Situation.....		194,400		194,400	194,400	
Annual reports.....	18,067	48,434		66,501	49,274	17,227
Circulars.....	444,195	326,500	143,750	914,445	435,820	478,625
Climatological data.....		11,715		11,715	11,715	
Climatological data (section summary).....		67,000		67,000	67,000	
Clip Sheet.....		327,600		327,600	327,600	
Crops and Markets.....		1,782,017		1,782,017	1,782,017	
Department bulletins.....	192,742		10,000	202,742	148,123	54,619
Department circulars.....	97,698		20,000	117,698	62,231	55,467
Experiment station bulletins and reports.....	3,655	20,450		24,105	23,375	730
Experiment Station Record.....		69,850		69,850	69,850	
Extension Service Review.....		120,000		120,000	120,000	
Farmers' bulletins.....	7,993,915	605,000	5,587,438	14,186,353	7,432,813	6,753,540
Farmers' bulletin lists.....	882,200		2,100,000	2,982,200	2,342,000	640,200
Forest Service recreational folders.....	88,530	118,000		206,530	206,530	
Indexes.....	11,772	31,175	250	43,197	33,086	10,111
Inventories of seeds and plants imported.....		4,500		4,500	4,500	
Journal of Agricultural Research.....		37,870		37,870	37,870	
Journal of Agricultural Research separates.....		81,750		81,750	81,750	
Leaflets.....	1,002,575	210,000	592,500	1,805,075	816,011	989,064
Miscellaneous circulars.....	183,700		8,500	192,200	38,566	153,634
Miscellaneous publications.....	708,007	578,350	244,100	1,530,457	889,049	641,408
Monthly List of Publications.....		169,000		169,000	169,000	
Monthly Weather Review.....		18,000		18,000	18,000	
Monthly Weather Review separates.....		10,750		10,750	10,750	
North American Fauna.....	1,157			1,157	1,157	
Posters.....	194,944	72,750	19,000	286,694	106,030	180,664
Public Roads.....		49,500		49,500	49,500	
Service and regulatory announcements.....	105,498	754,375	140,100	999,973	892,153	107,820
Soil surveys.....	26,800	44,450		71,250	30,538	40,712
Statistical bulletins.....	38,430	16,500	1,200	56,130	40,901	15,229
Technical bulletins.....	290,124	156,900	6,000	453,024	267,114	185,910
Unnumbered publications.....	410,866	740,550	41,040	1,192,456	520,058	672,398
Weekly weather crop report and snow and ice bulletins.....		239,000		239,000	239,000	
Yearbooks.....	13,694			13,694	12,804	890
Yearbook separates.....	216,014	47,600	1,700	265,314	140,582	124,732
Total.....	12,924,583	6,953,986	8,915,578	28,794,147	17,671,167	11,122,980

## PERSONNEL

The Division operated during the year with the reduced personnel brought about by the economies of the year previous, when the personnel was reduced by 19. Because of the difficulties encountered in keeping up to date with the distribution work, the Congress authorized an increase of three positions in the Distribution Section. To facilitate the handling of the distribution work the units handling the miscellaneous correspondence and congressional requests were consolidated. This arrangement should accomplish greater unity, flexibility, and efficiency of operation in handling requests for publications.



## NEW PUBLICATIONS ISSUED DURING THE YEAR

## Farmers' Bulletins:

- 1726. Treatment and Care of Tree Wounds.
- 1728. Flax-Fiber Production.
- 1729. Machinery for Dusting Cotton.
- 1730. Rabbit Production.
- 1731. Alfalfa Varieties in the United States.
- 1734. Making American Cheese on the Farm for Home Consumption.
- 1735. Pea Diseases and Their Control.
- 1736. Anthrax.
- 1737. Stop Gullies—Save Your Farm.
- 1738. Farmhouse Plans.
- 1739. Pear Growing in the Pacific Coast States.
- 1740. Vetch Culture and Uses.
- 1741. Bur-Clover Cultivation and Utilization.
- 1742. Game Laws for the Season 1934-35.
- 1743. Hotbeds and Cold Frames.
- 1744. The What and How of Hybrid Corn.
- 1745. Cotton Diseases and Methods of Control.
- 1746. Subsistence Farm Gardens.

## Leaflets:

- 104. Crested Wheatgrass.
- 105. Quality Guides in Buying Ready-Made Dresses.
- 106. Prevent Storage Rots of Sweetpotatoes.
- 107. The Barrel Seed Scarifier.
- 108. Controlling Kidney Worms in Swine in the Southern States.
- 110. Why Red Clover Fails.
- 111. Quality Guides in Buying Household Blankets.
- 112. Cooking American Varieties of Rice.

## Miscellaneous Publications:

- 172. Bibliography on Land Settlement, with Particular Reference to Small Holdings and Subsistence Homesteads.
- 192. A Review of the Patents and Literature on the Manufacture of Potassium Nitrate with Notes on Its Occurrence and Uses.
- 195. A Plan for the Management of Brown Bear in Relation to Other Resources on Admiralty Island, Alaska.
- 196. Floods and Accelerated Erosion in Northern Utah.
- 197. The Hurricane.
- 198. An Annotated Bibliography of the Hessian Fly, *Phytophaga destructor* (say).
- 199. Barley Diseases Controlled by Seed Treatment.
- 200. Manual of the Grasses of the United States.
- 202. Federal Legislation, Rulings, and Regulations Affecting the State Agricultural Experiment Stations.
- 203. Cotton and Cottonseed.
- 205. Economic and Social Problems and Conditions of the Southern Appalachians.
- 206. The Naval Stores Station of the Bureau of Chemistry and Soils.
- 207. Raising Reindeer in Alaska.
- 208. Motion Pictures of the United States Department of Agriculture, 1934.
- 209. A Naval Stores Handbook Dealing with the Production of Pine Gum or Oleoresin.
- 210. Status of Waterfowl in 1934.
- 211. Officials and Organizations Concerned with Wildlife Protection, 1934.
- 212. A Low-Cutting Sled Corn Cutter.
- 213. High-Quality Cream for Butter Making is Easily Produced by Following 3 Important Steps.
- 214. Workers in Subjects Pertaining to Agriculture in State Agricultural Colleges and Experiment Stations, 1934-35.
- 215. The Agricultural Outlook for 1935.
- 216. Meat Dishes at Low Cost.
- 219. Treat Seed Grain.
- 220. Directory of the Bureau of Entomology and Plant Quarantine, 1935.
- 221. Soil Blowing and Dust Storms.
- 222. The Direct Marketing of Hogs.

## Circulars:

- 300. The Dairee Date, A Promising Mesopotamian Variety for Testing in the Southwest.
- 314. Community Production of Acala Cotton in New Mexico.
- 316. Agronomic Evaluation Tests on Mechanical Blocking and Cross Cultivation of Sugar Beets.
- 317. Protection of Orchard and Shade Trees and Ornamental Shrubs from Injury by the Japanese Beetle.
- 318. A New Method of Self-Pollinating Cotton.
- 319. Fertilizer Studies with Sugar Beets in the Arkansas Valley Area, Colo., 1921-28.
- 320. Report on a Preliminary Field Survey of the So-Called "Alkali Disease" of Livestock.
- 321. Use of Farm Machinery for Corn-Borer Control in the One-Generation Area.
- 322. Outbreaks of the Dutch Elm Disease in the United States.
- 323. Trading in Privileges on the Chicago Board of Trade.
- 324. Studies on Handling Sugarcane Frozen Early in March in Advance Stages of Development.
- 325. Field Experiments with Vernalized Wheat.
- 326. Protecting Plants in the Home Yard from Injury by the Japanese Beetle.
- 327. Influence of Spacing and Time of Planting on the Yield and Size of the Porto Rico Sweetpotato.

## Circulars—Continued.

328. Methods of Reestablishing Buffalo Grass on Cultivated Land in the Great Plains.
329. Manufacture, Composition, and Utilization of Dairy Byproducts for Feed.
330. Immunity of Viking, A Norwegian Red Currant, to *Cronartium ribicola* and *C. occidentale* under Greenhouse Conditions.
331. Walnut Blight and Its Control in the Pacific Northwest.
332. General Information about the Japanese Beetle in the United States.
333. Sample Plots in Silvicultural Research.
334. Characters Useful in Distinguishing Larvae of *Popillia japonica* and Other Introduced Scarabaeidae from Native Species.
335. Distillate Burners.
336. Cooling Milk on the Farm with Small Mechanical Outfits.
337. Field Practices Affecting the Control of Cotton Root Knot in Arizona.
338. Distance of Planting Rural New Yorker No. 2 and Triumph Potatoes as Affecting Yield, Hollow Heart, Growth Cracks, and Second-Growth Tubers.
339. A Program of Waterfowl Restoration.
340. Effect of Parboiling Rough Rice on Milling Quality.
341. The Rusts of Cereal Crops.
342. The Waterfowl Flyways of North America.
343. Variety Tests of Sugarcane in Louisiana during the Crop Year 1932-33.
344. Causes of Decadence in the Old Groves of North Dakota.
345. Barrel and Disk Seed Scarifiers.
346. Insect Parasites and Predators of Insect Pests.
347. Effect of Cover on Surface Run-Off and Erosion in the Loessial Uplands of Mississippi.
348. Quail-Food Plants of the Southeastern States.
349. The Disposal by Burial of Fruit Infested with Larvae of the Mexican Fruit Fly.
350. Economic Importance of Red Rot and Comparative Susceptibility of Some Sugarcane Varieties in the Southern United States.
351. Notes on the Habits of Certain Coprophagous Beetles and Methods of Rearing Them.
352. Packaging, Curing, and Merchandising American Cheddar Cheese in Cans.
353. The Dutch Elm Disease Eradication Project—Federal, State, and Local Cooperation.
354. The Farm Real Estate Situation, 1933-34.
356. Trapping Experiments for the Control of the Cigarette Beetle.
358. The Forest-Tax Problem and Its Solution Summarized.

## Technical Bulletins:

415. Shortening the Rest Period of the Potato.
420. Poplars, Principal Tree Willows, and Walnuts of the Rocky Mountain Region.
421. The External Anatomy of the Parlatoria Date Scale, *Parlatoria blanchardi* Targioni Tozzetti, with Studies of the Head Skeleton and Associated Parts.
424. Influence of Storage Temperatures on the Rest Period and Dormancy of Potatoes.
426. The Relation of Fertilizers to the Control of Cotton Root Rot in Texas.
427. The Use of Naphthalene against the Japanese Beetle.
428. Cercospora Foot Rot of Winter Cereals.
429. Pile Trestles as Channel Obstructions.
430. The Physical and Chemical Characteristics of the Soils from the Erosion Experiment Stations—Second Report.
431. A Revisional Study of the Genus *Scolytus* Geoffroy (*Eccoptogaster* Herbst) in North America.
432. Studies of the Irrigation of Pear Orchards on Heavy Soil Near Medford, Oregon.
433. Physiologic Specialization in *Puccinia coronata avenae*.
434. Refrigerated Transportation of Bartlett Pears from the Pacific Northwest.
435. Comparison of Scabbed Barley, Normal Barley, and Yellow Corn in Diets for Laying Chickens.
436. Cotton Root Rot as Affected by Crop Rotation and Tillage at San Antonio, Texas.
437. Development of the Swine Nematode *Strongyloides ransomi* and the Behavior of Its Infective Larvae.
438. The Effect of Homogenization on Certain Characteristics of Milk.
439. Policies Governing the Ownership of Return Waters from Irrigation.
440. Shrinkage and Heat Penetration during the Roasting of Lamb and Mutton as Influenced by Carcass Grade, Ripening Period, and Cooking Method.
441. The Biology of *Cremastus flavo-orbitalis* (Cameron), an Ichneumonid Parasite of the European Corn Borer.
442. Bridge Piers as Channel Obstructions.
443. Application of Steam in the Sterilization of Soils.
444. Studies on the Mexican Fruit Fly, *Anastrepha ludens* (Loew).
445. Market Distribution of Car-Lot Shipments of Fruits and Vegetables in the United States.
446. Yields of Barley in the United States and Canada, 1927-31.
447. The Pepper Weevil.
448. Boron in Soils and Irrigation Waters and Its Effect on Plants, with Particular Reference to the San Joaquin Valley of California.
449. Storage of Mill Cane.
450. Relation of Maturity and Handling of Bartlett Pears in the Pacific Northwest to Quality of the Canned Product.
451. Cotton Production in Egypt.
452. Experiments with Nitrogen Fertilizers on Cotton Soils.
453. Responses of Strawberry Varieties and Species to Duration of the Daily Light Period.
454. Agricultural Investigations at the Belle Fourche (S. Dak.) Field Station, 1926-32.
455. The European Corn Borer and Its Controlling Factors in the Orient.
456. Life History of Lungworms Parasitic in Swine.
457. The Rubber Content of Two Species of *Cryptostegia* and of an Interspecific Hybrid in Florida.



## Technical Bulletins—Continued.

- 458. Histological Characters of Flax Roots in Relation to Resistance to Wilt and Root Rot.
- 460. Studies of *Empoasca fabae* (Fabr.), a Parasite of the European Corn Borer, in the Lake Erie Area.
- 461. Base Exchange and Related Properties of the Colloids of Soils from the Erosion Experiment Stations.
- 462. Composition of the Developing Asparagus Shoot in Relation to its Use as a Food Product and as Material for Canning.
- 463. Biological and Ecological Factors in the Control of the Celery Leaf Tier in Florida.
- 464. Agricultural Investigations on the Newlands (Nev.) Reclamation Project.
- 465. Seasonal Variations in Carrying Capacity of Pastures for Dairy Cows in Milk.
- 466. Agriculture in Southern Africa.
- 467. The Crested Myna, or Chinese Starling, in the Pacific Northwest.
- 468. Efficacy of Anthrax Biologics in Producing Immunity in Previously Unexposed Animals.
- 469. A Method of Rural Land Classification.
- 470. Investigations on Runner and Fruit Production of Everbearing Strawberries.
- 471. Chemical Studies of Infertile Soils Derived from Rocks High in Magnesium and Generally High in Chromium and Nickel.
- 473. Heavy Cottonseed Meal Feeding in Relation to Udder Troubles in Dairy Cows.
- 474. Marketing Apples.
- 475. Influence of Storage Temperature and Humidity on Keeping Qualities of Onions and Onion Sets.
- 476. Forest Improvement Measures for the Southern Appalachians.
- 477. *Apanteles solitarius* (Ratzeburg), an Introduced Braconid Parasite of the Satin Moth.

## PRESS SERVICE

Drought and problems created by the drought, along with economic information related to current agricultural developments, figured prominently in the Department's service of information extended through the press.

The almost unprecedented drought of 1934 created a wide demand for information about conditions in the drought area and about general weather trends and phenomena. This demand came not only from the drought zones, and from the general public, but also from business groups and others whose interests were affected by the drought.

As part of its service of information on drought conditions the Press Service encouraged the Weather Bureau and the Bureau of Agricultural Engineering to make public the results of surface- and ground-water investigations, and to issue frequent reports on the supply of irrigation water. Washington correspondents and the press associations relayed much of this material from Washington by wire; two reports of special interest were placed on the news ticker.

## MEETING DROUGHT PROBLEMS

Of greater significance than the information about weather and drought conditions themselves was the extensive service of information to farmers about how to meet problems created by the drought. The press afforded a medium for making quickly available to farmers throughout the drought area reliable information on substitute crops and feeds, dates and methods of planting emergency crops, the use and construction of inexpensive pit silos to conserve any available feed supplies, general adjustments to meet the feed shortage, and plans of Federal agencies to meet the emergency situation.

Because of the general shortage of seed resulting from the drought, the Press Service gave facts about the relative supplies of various types of seed, and where and how they might be used. For example, press releases were issued during the spring of 1935 to point out the general availability of soybean seed. At the same time farmers were warned about various poor and unadapted seeds being marketed by unscrupulous seedsmen seeking to profit from the emergency situation. This information was valuable not only in the drought region but also to farmers throughout the country.

The dust storms of 1934, more than any other one thing, aroused the country to the menace of erosion by wind and water. For more than 10 years, the Department has been disseminating information about the cause, prevention, and cure of erosion. Research and investigation, followed by informative reporting of unfamiliar facts, had formed a background for a true appreciation of what the dust storms and other types of erosion mean. This background has been credited by erosion officials with greatly facilitating the work of control.

## ECONOMIC RELEASES

One of the most interesting developments in Press Service work is the increasing interest of farmers, many consumers, and editors in economic information.

The Department's reports are now played up prominently—reports on the price and supply situation; foreign production and marketing; cotton production in Egypt, India, and Brazil; wheat production in Canada, Argentina, Australia, and Europe; and hog production and import quotas in the British Empire, Denmark, Germany, and other countries.

Among the other important developments in agriculture were the outbreak of grain rust, the continued spread of the Dutch elm disease, and the outbreak in the South of the screwworm pest of livestock. The Press Service maintained a continuous service of reports on such developments, along with information about how to meet the problems created.

#### FOOD AND DIETS

The special service for household editors of farm journals, newspapers, and syndicates continued to be in general demand; it included about 180 articles and 93 illustrations.

This service covers the work of various bureaus of interest, especially to women. Information of a seasonal character is sent out well in advance so that editors can time its publication appropriately. The reports on fruit and vegetable supplies, prices, and market receipts issued by the Bureau of Agricultural Economics provide the basis for articles on the use of foods which will be abundant. The weekly Market Basket, containing seasonable information on the low-cost diet, continued in great demand. It has been a most effective way to reach the housewives with facts that help maintain family standards in spite of reduced incomes.

#### CLOSER CONTACT WITH PRESS

Since there are now two sources of important news in the Department of Agriculture—the Agricultural Adjustment Administration and the regular bureaus—there has been an increase in the number of reporters who either make headquarters at the Department or watch it intently as a source of news. The volume of agricultural news printed nowadays, even aside from that dealing directly with agricultural adjustment programs—which receives wide attention in the press—is vastly greater than it was 5 or 10 years ago.

This factor accounts for the great increase in the work which members of the Press Service must carry on direct with reporters, correspondents, and special writers. Two men are kept busy much of the time filling the personal requests of representatives of the press for information about Department activities, discoveries, policies, and plans. Because of their general familiarity with the work of all parts of the Department, members of the Press Service are able to discuss the various phases of subject matter of a proposed article with a writer, suggest collateral material, and arrange interviews with specialists best qualified to supply authoritative detailed information. The Press Service encourages the scientists and administrators of the Department to talk frankly and fully with writers. The interest of the press in agriculture is now such that even if the Department ceased issuing mimeographed releases, the Press Service would still have a full-time job. Of course, in the interests of farm journals and other publications not usually represented by Washington correspondents, and to achieve greater accuracy, mimeographed releases are essential.

#### SCIENTIFIC INFORMATION

More than ever before, scientific journals are making use of articles prepared in the Press Service, reporting in popular language and in simple style the outstanding results of scientific research. This reflects a growing appreciation among scientists of the value to science as well as to the public of a wide understanding and appreciation of scientific advances. It reflects, too, a growing confidence among science editors in the accuracy and reliability of such material. It demonstrates that scientific information can be popularized without detracting from its value and dignity. There is considerable significance in the fact that many scientific journals are turning to articles written in popular language to interpret scientific advances to scientists.

#### ILLUSTRATED PRESS RELEASES

One high spot in the improvement of the informational material for the press is the introduction of the photolith method as a practical and economical way of illustrating releases and providing illustrative material which may



be reproduced in the press at a slight cost to the publisher. It is often difficult to give, through the written word, a clear and readily comprehended picture of the extent of a drought which takes in parts of a dozen or more States. It is equally difficult to describe, say, the applicability of different varieties of forage crops to meet drought conditions. An illustration is really required to make the information effective.

By using a slightly better grade of paper, it is possible to include as a part of a press release a print of a simple line drawing, a map, or a graph. The process has even reproduced photomicrographs well enough so that newspapers could again reproduce them for illustrations. Maps have proved particularly effective in illustrating news reports of drought and flood conditions, of disease and pest spreads, and they have also been used to show the limitations of types and varieties of crops. Graphs of significance in economic studies can now accompany the news reports at only a fraction of the cost of other means of distributing the same information. Often the story and the graph or map are included on a single page. A simple line cut of some improvement in machinery or of an improved construction method makes technical descriptions far more comprehensible than are written descriptions alone.

#### **"GOVERNMENT PROPAGANDA"**

During the year considerable criticism in Congress, in the press, and elsewhere, was directed at "Government propaganda." One bill introduced in the Senate called for an investigation of Federal informational activities and requested the submission to Congress of copies of all publications printed during the year. Press work was scrutinized with particular care. The Department of Agriculture was able to show what has always been true—that its information is not propaganda in the malodorous sense of that term, nor publicity in the usual commercial sense; rather that its information is factual, useful, and desired by thousands of editors and the public. I have repeatedly stated that the information forces of this Department are not interested in "selling" the Department or any of its officials to the public, but only in disseminating facts of genuine social, economic, and scientific value to the people of this country. Its purpose is to help carry out the mandate of the organic act, which calls upon the Department to acquire and diffuse agricultural information in the most general and comprehensive sense. The Department was able to show, to the satisfaction of those most concerned, that its informational work is fully provided for by many laws and is carried on strictly in accord with specific appropriations made for the purpose.

#### **PERSONNEL**

A few of the bureaus of the Department do not have information staffs adequate to meet their obvious obligation to pass on to the public the facts which have general economic and social value. The ineffectiveness of relying on inadequately trained personnel has long been evident. The Press Service, too, is somewhat understaffed, both as a result of the increasing time required for work direct with press representatives and also because there has been a reduction in personnel.

#### **RECORD OF WORK**

Approximately 2,450 press releases were distributed during the year. Of the total, 1,045 were distributed for the A. A. A. Each release was sent only to the section of the country or to the type of publication interested.

#### **RADIO SERVICE**

Dissemination of useful information by radio during the fiscal year followed much the same pattern as in preceding years. However, with the appointment during the year of a full-time extension specialist to maintain closer contacts with the State agricultural extension editors and the individual stations cooperating with the Department, it became possible to get a clearer view than we have had heretofore of trends in agricultural program making for broadcast on individual stations.

#### **DEVELOPMENT OF DAILY NETWORK PROGRAMS**

The daily network programs in which the Department participated are the National Farm and Home Hour, broadcast by 50 stations in the eastern, central, and mountain time zones, and the Western Farm and Home Hour, broadcast by 10 stations in the Pacific and mountain time zones.

The agricultural-program directors for the National Broadcasting Co. continued to exhibit the same cooperative attitude as in the past, exerting every effort to make the Department's programs of maximum usefulness to farmers and homemakers. They created greater opportunities for presenting information of value by increasing the allowance for picking up programs at points distant from the key stations of the networks. This was especially helpful in the improvement of the Western Farm and Home Hour program; arrangements were made to put officials of the Department and cooperating agencies on the air from Spokane, Seattle, Portland, and Los Angeles, as well as from San Francisco.

The set-up for the Western Farm and Home Hour was further improved from an information standpoint by the action of the company in allowing the network to be split into regional sections on certain days so that two programs could go on the air simultaneously, each serving a different section of the Western States.

A disturbing development as the fiscal year ended was the possibility that the broadcasting company would shift the schedule of the Western Farm and Home Hour at the conclusion of daylight saving time on September 30, 1935, placing it at 11:30 a. m. to 12:15 p. m. (Pacific standard time) in place of the present schedule of 12:15 to 1 p. m. (Pacific standard time). The Radio Service proceeded immediately to determine the probable effect of the change upon the convenience of rural listeners.

We gathered opinions on this point from State directors of extension work in the region and from the western program director of the Department. Jennings Pierce, the director of agriculture for the Pacific division of the National Broadcasting Co., also has made an investigation covering this and other points.

Extension directors in the Pacific time-zone States said that the schedule proposed for the broadcast would be less convenient than the present schedule for rural listeners in the Pacific time zone, where 85 percent of the potential rural listeners are located and that the audience for the broadcast, therefore, would be reduced.

Extension directors in the mountain time-zone States, where are located 15 percent of the potential rural audience, said the change in time would make the schedule more convenient for rural listeners. Since those consulted were agreed that the heavy majority of potential rural listeners would be inconvenienced by the shift the Department did not voluntarily assent to the shift, and proposed that if the company deemed it necessary to make the shift, the company join with the Department in investigating the effects of the change on convenience of listeners, and if it proved adverse, restore the program to an hour more convenient for the majority of listeners.

At the conclusion of the fiscal year the question remained undecided.

A second disturbing development in relationships concerned the matter of station cooperation. Late in the preceding fiscal year and during the present fiscal year, the Western Farm and Home Hour program was shifted from the stations in Portland, Seattle, and Spokane, generally considered the primary stations for service to the surrounding rural areas, to stations generally considered to give secondary service to rural areas. The proportion of audience mail originating in the area of coverage from these three points dropped off in every instance following the change. Presumably the number of families served on the new station assignment was smaller than on the previous station assignment. In the absence of other discernible factors that might bring about a decrease in mail returns, it seemed that the shift in station assignments was responsible; and both the Department Radio Service and the network agricultural-relations department are endeavoring to obtain reinstatement of the primary stations in the network broadcasting the Western Farm and Home Hour.

A similar, though less acute, difficulty occurred at times during the year with respect to station assignments for the National Farm and Home Hour. From time to time different stations dropped out of the network for periods of days or weeks, then returned. Also a few stations were reported canceling talk periods of the hour for commercial spot announcements. The agricultural director of the broadcasting company, as the year closed, was endeavoring to better this situation, which obtained with only 6 of the 50 stations in the network broadcasting the National Farm and Home Hour.



**SUBJECT MATTER OF NETWORK BROADCASTS**

The subject matter discussed in the network programs consisted, of course, of the information of greatest public importance coming from the Department and cooperating agencies. Significant developments in the subject matter of the broadcasts on the daily network programs were as follows:

*National Farm and Home Hour.*—Beginning with the first Friday program in January and continuing on each succeeding Friday, officers of the Department of Agriculture and other departments and of the National Resources Board (later the National Resources Committee) discussed each week a major phase of the report of the National Resources Board. This series of programs constituted the most extensive presentation in lay language of the Board's momentous report. It was carried in the Department periods of the National Farm and Home Hour with the aim of integrating the public's views of the manifold problems, physical and human, involved in the conservation of the Nation's natural resources.

Beginning with the last Tuesday in February and continuing for 9 consecutive weeks, the Department presented each Tuesday discussion programs dealing with the major topics which were under consideration in discussion groups organized, with the cooperation of the Department, by land-grant colleges in 10 States. In the report of the results of this discussion-group movement, it was stated that the radio broadcasts performed a most useful function both by way of arousing interest and participation in the discussion groups and of giving participants material to assist them in formulating their opinions for expression at the group meeting.

Following the conclusion of the discussion-group series, the Tuesday programs were devoted to discussions of the objectives and achievements of the major scientific-research programs being carried on by the Department. This series will continue indefinitely. Its aim is to place before the public scientific knowledge that has a bearing on the solution of the shifting problems in the field of improving methods of production and distribution.

*Western Farm and Home Hour.*—As it serves a more homogeneous agricultural region than the National Farm and Home Hour, the Western Farm and Home Hour programs can carry quite specific information concerning market trends and quotations. Therefore, a special market news service of region-wide interest was inaugurated on the Western Farm and Home Hour. Through the cooperation of the Western Field Contact Section of the Information Division of A. A. A. a series was arranged for the information of growers of specialty crops for which market-agreement programs existed. The 4-H club broadcasts for the Western States also were greatly improved by wider participation of the different State extension-service organizations.

During the year the National and Western Farm and Home Hour programs continued to take to listeners daily the latest available information concerning the adjustment programs in which farmers were participating and the seasonal recommendations of scientists and extension workers concerning the improvement of farm and home practices.

**DEVELOPMENT OF THE SYNDICATED SERVICES**

Attention of the Radio Service to the syndicate programs for transmission by individual stations was concentrated on improving of cooperative relationships with the State agricultural extension services and the radio-station managements on procuring better arrangements for delivery of the programs through participation of county extension agents located in the towns where cooperating broadcasting stations are located or within feasible traveling range, and on providing more regionally applicable information in the copy sent from Department headquarters.

With the appointment of a full-time radio-extension specialist, much closer contacts were possible with State extension directors, editors, and county agents, and with the managers of cooperating stations. The extension specialist visited 30 States. At the conclusion of each of his regional field trips, he summarized his findings for transmission to all State extension directors and editors. In general, he found a disposition of the directors and editors to make more effort to prepare useful radio programs for stations which would cooperate in transmitting them. He found also an encouraging development of broadcasting by county agents. In this direction, it seems clear, future progress in broadcasting information to farmers and homemakers through individual stations must be made. Broadcasts by county agents can give not only Federal and State information but also completely localized information of maximum

value to the farm people served by the stations. Hence the stations are more ready to place such programs on schedules which will be most convenient for farm family listeners. Also, county agents are able to stimulate interest in and attendance at meetings, demonstrations, etc., where the interest aroused by the radio broadcast can be made more fruitful by detailed instruction.

At least 50 county agents are now handling informational broadcasts through cooperating stations. Another 50 or more are taking part in broadcasts which present county agents from a rather wide territory. Examples are the broadcasts arranged by New York State stations in Schenectady, Syracuse, and Buffalo, which presented during the course of a year from 6 to 30 county agricultural agents. Another example is the broadcast on a Memphis station which presented during the course of a year talks and interviews in which 25 county agents from a tri-State territory took part.

One weakness of extension broadcasting is the lack of personnel in the State extension editorial offices to prepare basic material for the use of the radio-station personnel and county agents who transmit programs over the individual stations. However, the Division of Cooperative Extension reports that in many States there is disposition to employ new funds made available by the Bankhead-Jones Act to bolster the editorial staffs so that they may give more attention to this important function.

Managers of some independent stations are tending to place the purely manuscript syndicate services on schedules less convenient for farm listeners. The managers apparently feel that the economic pressure on them to get revenue from the more salable noon-hour time and the lesser public-service value of the manuscript programs which cannot be made completely applicable to local information needs in all respects, justifies them in devoting the noon hours solely to the production of revenue.

On the other hand, the majority of the stations with which we have had experience in county agent broadcasting seem to feel that the greater public-service value derived from the localized broadcasts which the agents can give, justifies the station management in foregoing possibilities of deriving revenue for some noon-hour time and devoting it to agricultural-service programs. However, we have on record some instances where the county agent programs were shifted out of the noon-hour time to make way for revenue-yielding programs.

In the field of preparation of the syndicate programs in Washington, we are giving recognition to the trend toward news-type agricultural broadcasts presented by announcers. Our releases now carry news-item discussions of the subject matter to be presented rather than the longer, more completely informing type of discussions which we have used in the past 2 years. This switch is dictated by another consideration—the fact that publications have become more freely available, so again we can use the broadcasts to advise the listeners of the availability in published form of seasonal information and will not have to depend so completely as in the past 2 years upon the broadcasts themselves to give all of the information that we have to offer.

The virtual break-down of the press-radio agreement in April 1935, and the resulting large increase in volume of news broadcasting, indicate that the Radio Service also must cooperate with the Press Service in supplying information to the news associations which operate in the radio field. The press association staffs in Washington of course now gather the Department's current economic reports and news of the adjustment programs. The radio editors of the associations may select such matter from each day's file of telegraphic reports. The field that may need development is that of supplying for the news service to radio stations information of seasonal usefulness on farm and home practices.

In one respect, the radio work has stood still during the past year—this is in stimulating broadcasting to homemakers by home demonstration agents. Plans were laid to take hold of this phase of the farm and home broadcasting problem during the coming year. A mimeographed periodical for exchange of information on agricultural broadcasting in the several States is badly needed, for one extension specialist cannot by visits and correspondence keep information circulating freely on this phase of extension methodology. Another urgent project to which some consideration has been given is the publication of a manual for the use of the Department and State forces on the preparation and presentation of agricultural and home economics broadcast programs. To speed up the flow of information concerning radio methodology, we have made arrangements to keep in closer contact than ever before with the regional staff of the Federal Division of Cooperative Extension and also with the subject-matter staff.









# REPORT OF THE LIBRARIAN, 1935

UNITED STATES DEPARTMENT OF AGRICULTURE,  
LIBRARY,  
Washington, D. C., August 31, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I have the honor to submit herewith the report of the Library for the fiscal year ended June 30, 1935.

Sincerely yours,

CLARIBEL R. BARNETT,  
*Librarian.*

The following summary of the work of the past year is based on the manuscript reports submitted by the heads of the divisions of the Library and on the reports of the branch libraries in the various bureaus. In the body of the report are four statistical tables showing (1) accessions to the Library, 1934 and 1935, (2) material catalogued, 1934 and 1935, (3) cards in the Agr series prepared for printing, and printed cards received, 1934 and 1935, and (4) binding work, 1934 and 1935. At the end of the report are three additional tables, namely, (5) the combined statistics of circulation, (6) the statistics of bureau libraries, and (7) the financial statement.

## ACCESSIONS

The number of accessions to the Library for the fiscal year 1935 compared with those received in the fiscal year 1934 is shown in table 1.

TABLE 1.—Accessions to the Library, 1934 and 1935

Item	1934	1935
<b>Purchases:</b>		
Volumes.....	1, 218	1, 177
Pamphlets.....	109	111
Maps (and charts).....	1	5
Serials.....	276	327
Continuations.....	380	397
Total.....	1, 984	2, 017
<b>Gifts:</b>		
Volumes.....	1, 772	2, 605
Pamphlets.....	1, 564	2, 280
Maps (and charts).....	34	31
Continuations.....	5, 058	6, 060
Total.....	8, 428	10, 976
<b>Bindery continuations.....</b>	<b>2, 938</b>	<b>1, 268</b>
Volumes laced in binders.....	1, 068	705
Current entries.....	270	269
Total.....	14, 688	15, 235

The amount spent for books and periodicals was \$2,224.75 more than in the previous year. This was not due to an increase in the appropriation but to the fact that salary lapses were used for this purpose, but even then the funds for books and periodicals were exhausted in the first half of the fiscal year. This seriously handicapped the service of the Library. If the Library is to be able to fulfill at all adequately its function of providing the important

current books and periodicals on the subjects of interest in the work of the Department, its book fund must be largely increased. More funds are also much needed for filling in gaps in the files of scientific and economic journals and for the purchase of old scientific books of historical importance. Because of the Library's limited funds, no additions of note have been made during the past 3 years to the collection of old and rare books, and little progress has been made in completing important series.

The number of books, pamphlets, and continuations received during the year by gift and exchange was fortunately larger than in the previous year. The extensive files of official publications which the Library maintains form one of its greatest assets. Grateful acknowledgment is made to all the institutions, societies, officials, and publishers in this country and abroad who have so generously contributed to the Library's resources.

On July 1, 1935, the Library contained 258,018 accessioned volumes and pamphlets. The actual number, however, is believed to be not much less than 300,000, as the Library contains many thousands of pamphlets, volumes of periodicals, bulletins, and reports in temporary binders which have not been accessioned. An accurate count of the volumes and pamphlets, which it was hoped could be made the past fiscal year, was not possible on account of lack of assistance.

### CATALOGING

The Catalog Division (Helen M. Thompson, chief) reports on the material cataloged (by classes) during the year 1935, as compared with the record of material cataloged in 1934, as given in table 2.

TABLE 2.—*Material cataloged, 1934 and 1935*

Item	1934	1935
Volumes.....	2,990	3,782
Pamphlets.....	1,673	2,391
Maps and charts.....	35	36
Continuations and serials.....	5,714	6,784
Total.....	10,412	12,993
Bindery continuations.....	2,938	1,268
Volumes in binders.....	62	72
Additions to binders.....	1,068	705
Current entries.....	270	269
Changed titles.....	71	96
Total.....	14,821	15,403
Pamphlets cataloged (by author only).....	121	376
Reprints (reprint collection).....	4,822	157

The number of cards prepared for printing by the Library of Congress in what is called the "Agr." series and the number of printed cards received is given in table 3.

TABLE 3.—*Cards in the Agr series prepared for printing and printed cards received, 1934 and 1935*

Item	1934	1935
Cards sent to be printed:		
Accessions.....	388	325
Department publications.....	453	419
Agricultural periodicals.....	143	96
Total.....	984	840
Printed cards received:		
Accessions.....	432	306
Department publications.....	442	271
Agricultural periodicals.....	112	80
Total.....	986	657



The cards added to the main catalog numbered 27,379, while 4,412 were withdrawn, making a net increase of 22,967. The net increase for the previous year was 23,562. The total number of cards contained in the main dictionary catalog of the Library is now approximately 800,000.

The number of cards added to the various catalogs and indexes maintained by the branch libraries in the bureaus and divisions is shown below:

Agricultural Economics-----	16,470	Entomology and Plant Quar-	
Division of Cotton Mar-		antine-----	<sup>1</sup> 6,404
keting-----	<sup>1</sup> 4,189	Division of Bee Culture--	1,000
Agricultural Engineering-----	<sup>1</sup> 3,100	Experiment Stations-----	<sup>1</sup> 6,858
Animal Industry-----	<sup>1</sup> 6,282	Forest Service-----	<sup>1</sup> 16,158
Animal Husbandry Divi-		Home Economics-----	857
sion-----	<sup>1</sup> 210	Plant Industry-----	<sup>1</sup> 27,912
Chemistry and Soils-----	1,938	Public Roads-----	<sup>1</sup> 20,193
Dairy Industry-----	<sup>1</sup> 2,225		

The total number of cards in the special catalogs and indexes in the branch libraries in the various bureaus is 2,912,519.

### PERIODICAL DIVISION

The Periodical Division (Lydia K. Wilkins, Chief) reports that the total number of different periodicals received by purchase, gift, and exchange was 4,493, as compared with 4,398 in 1934, the net increase for the year being 95. The number received by purchase was 1,384, and by gift, 3,109. In order to meet the demands for certain periodicals it was necessary to purchase 347 duplicate copies, making the total number of periodicals purchased 1,731, an increase of 31 over the number purchased the previous year. The Library also received 390 duplicates by gift and exchange for regular circulation, making the total number of periodicals handled during the year 5,230, an increase of 195 for the year. It is estimated that the number of separate issues received of current periodicals was 82,500, or an average of 275 a day.

The number of different dailies received was 174, and 47 extra copies. These are not included in the 5,230 current periodicals noted above, neither are the periodical publications of the Department nor the farm bureau publications. The number of farm bureau publications currently received during the past year was 177.

No separate record is kept in the Periodical Division of the number of continuations received, but the records of the Catalog Division show that 6,457 continuations were cataloged during the year.

### BINDING

The Binding Section of the Periodical Division (in charge of Joseph J. Canavin under the general supervision of Elizabeth G. Hopper, assistant chief) reports the binding work for the past year, compared with the previous year, as given in table 4.

TABLE 4.—*Binding work for the Library, 1934 and 1935*

Item	1934	1935
Books and periodicals sent to bindery-----	7,895	5,121
Volumes laced in temporary binders-----	2,329	1,913
Current serials added to binders-----	954	617

The large decrease in binding work was due in part to the interruption of the normal duties of the Binding Section, first, by the moving of the section to new quarters on July 1-17, 1934, and later by the moving of the Library to the new stacks in December 1934. All of the Binding Section staff helped in the moving of the Library to the new stacks for a period of 4 weeks. The most important reason for the decrease in the number of books sent to the Government Printing Office for binding was, however, the decrease in the

<sup>1</sup> Includes index entries.

Library's allotment of funds for this purpose from the printing and binding fund of the Department. The need for increased funds for binding is most urgent. An additional assistant for this work is also needed.

### USE OF THE LIBRARY

The Readers' Division (Emma B. Hawks, Associate Librarian in charge) reports that the reference use of the Library continued as heavy as in the previous year. Both years have unquestionably been the busiest in the history of the Library. The combined statistics of circulation in the main Library and the bureau libraries which are given in table 5 show a recorded circulation of 79,479 books and 270,975 current periodicals, a total of 350,454. As in previous years, it is necessary to point out that these figures indicate only approximately the use of the Library, a record of the circulation of periodicals not being kept in all of the bureau libraries.

No separate record is kept of the number of books lent by this Library to other libraries in Washington, but it is certain that the number has increased very materially in the past 2 or 3 years, as many demands have been made on the Library by other Government departments, particularly by the new emergency offices. Among the outside agencies which have been served are the Brookings Institution, Bureau of Railway Economics, Department of Commerce, Office of Education, Farm Credit Administration, Federal Housing Administration, Department of Labor, National Institute of Health, National Recovery Administration, National Resources Board, Reconstruction Finance Corporation, Resettlement Administration, Smithsonian Institution, Subsistence Homesteads, Tariff Commission, Tennessee Valley Authority, Treasury Department, and Chamber of Commerce of the United States.

At the request of the Department Graduate School, the Library was kept open for a half hour before official hours and an hour after official hours from April 12 to June 8, for the purpose of giving out books needed in the classes of the school, particularly the class in the Elements of Personnel Administration. The funds for paying the assistants were provided from the Graduate School funds. It would be most desirable to have the Library kept open until 6 p. m. throughout the year with the exception of the summer months, and it is hoped that Library funds to make this possible will be available in the near future.

The loans from this Library to libraries outside of Washington totaled 1,798. These loans were divided as follows: United States Department of Agriculture field service, 558; land-grant colleges and agricultural experiment stations, 797; other colleges, universities, and organizations, 280; commercial firms, 60; individuals, 64; foreign institutions and organizations, 39. With one exception loans were made to every State in the Union, the largest number being sent to New York State. Loans were also made to institutions in Canada, Mexico, the Philippine Islands, and Puerto Rico. In addition to the 1,798 books and periodicals lent to libraries outside of the city, 28 photostat copies and 18 typed copies were supplied, making a total of 1,844. To provide a true picture of the interlibrary loans of last year there should, also, be added to this total the 1,078 volumes from which film copies were supplied in lieu of sending the volumes themselves, making a grand total of 2,922 volumes the use of which was made available out of town the past year. This was an increase of 540 over the previous year. A description of the film-copying service is given in a subsequent paragraph.

Loans to this Library from other libraries in Washington were granted to the number of 5,852, an increase of 938 over the number of loans for the previous year. Of these, 5,038 were borrowed from the Library of Congress, an increase of 1,013 over the previous year. Interlibrary loans from libraries outside of Washington numbered 67. These were borrowed from 27 different libraries.

### BIBLIO-FILM SERVICE

The biblio-film service which has been operating in the Library on an experimental basis since the middle of November 1934 was inaugurated with the assistance of Atherton Seidell, of the National Institute of Health, and R. H. Draeger, of the Medical Department, United States Navy.<sup>2</sup> The camera which

<sup>2</sup>For full details see the following publication: Seidell, A. FILM STRIP COPIES OF SCIENTIFIC PUBLICATIONS. Science (n. s.) 81: 174-176. 1935.



is being used in making film copies of publications was made available for the experiment by Dr. Draeger who had built it a few months earlier for his own use. The purpose of the service is (1) to decrease interlibrary loans of books by supplying directly to individuals, film copies of scientific articles, particularly these contained in periodicals, and (2) to extend the use of the resources of the Library to isolated scientific workers without adequate scientific facilities. The records of the use of the service during the period November 15, 1934, to June 1935 show that it has been quite successful in fulfilling its purpose, for it has unquestionably reduced the number of books which it would have been necessary to send out of town on interlibrary loans, and in addition a number of libraries, firms, and individuals are now making use of the Library's resources that had not used it previous to the inauguration of the film service.

As noted in connection with the figures for interlibrary loans, the total number of volumes from which film copies of articles was supplied, was 1,078. The number of pages copied during the period November 15, 1934, to June 30, 1935, in lieu of sending the volumes from which they were taken was 19,660. Up to June 30, 1935, the number of different users of the film-copying service was as follows: United States Department of Agriculture field service, 14; land-grant colleges and agricultural experiment stations, 50; other colleges, universities, and organizations, 54; commercial firms, 38; individuals, 15; foreign institutions and organizations, 16; a total of 187. One commercial institution in California in a single order requested film copies from more than 200 volumes, the total number of pages copied being 5,639. An institution in Hawaii requested a film copy of a complete volume of a periodical which was out of print and difficult to obtain.

It has been somewhat surprising that so many institutions, firms, and individuals have wanted to make use of the service in spite of the fact that satisfactory projectors designed for reading film copies of publications were not available at a reasonable price. A number of those who have requested film copies have seemed to be content in the meantime to use dissecting or binocular microscopes and some have made enlarged prints from the films. On the whole, the experience of the past 7½ months seems to indicate that the service meets a real need in the scientific field and that its use will probably increase, particularly when suitable projectors become available at a reasonable price and when satisfactory projection prints can be supplied.

### BIBLIOGRAPHICAL WORK

In the Bureau of Agricultural Economics library there were prepared the following bibliographies and lists:

Miscellaneous Publication 203.—Cotton and Cottonseed. A list of publications of the United States Department of Agriculture on these subjects, including early reports of the United States Patent Office. Compiled by Rachel P. Lane. 149 pages. Washington, Government Printing Office, 1934.

Agricultural Economics Bibliography No. 54.—Measures of major importance enacted by the Seventy-third Congress, March 9 to June 16, 1933, and January 3 to June 18, 1934. Compiled by Vajen E. Hitz. 55 pages. November 1934. Mimeographed.

Agricultural Economics Bibliography No. 55.—List of periodicals containing prices and other statistical and economic information on fruits, vegetables, and nuts. Compiled by Esther M. Colvin. 258 pages. January 1935. Mimeographed.

Agricultural Economics Bibliography No. 56.—Consumption of fruits and vegetables in the United States. An index to some sources of statistics. Compiled by Mamie I. Herb. 125 pages. January 1935. Mimeographed.

In addition to these printed and mimeographed bibliographies, a large number of typewritten lists were prepared. Among the more important of these were the following: Agricultural Credit in Foreign Countries, 1927-1934: A Partial List of References, 10 pages; Commercial Canning of Fruits and Vegetables, June 1929-June 1934: A Selected List of References, 37 pages; Statistics of the Consumption of Milk in the United States: A Partial List of References, 20 pages; Vegetables: Selected References on the Marketing of Vegetables (supplementary to Bibliography on the Marketing of Agricultural Products, U. S. Department of Agriculture Miscellaneous Publications 150), 14 pages; Supplement to Foreign Competition with American Cotton: Selected List of Recent References (1932-34) in English, 3 pages; Frazier-Lemke Farm-Mortgage Act: A List of References, 6 pages; Tobacco Publications of the United States Department of Agriculture, 1929-34: A Preliminary List of References, 19 pages; Cotton in China: Some Recent References to Literature in English and German

on Production, Marketing, and the Textile Industry, 11 pages; The Southern Share Cropper: A Selected List of References, 15 pages.

In the Bureau of Agricultural Engineering library there were prepared the following bibliographies and lists: Magazines Contributing Most Frequently to the Index of Current Literature in Agricultural Engineering, 17 pages; Soil Erosion and its Prevention, 91 pages; Bibliography on Flood Control, 9 pages; Electricity on the Farm, 128 pages; New Building Materials, 7 pages.

In the Bureau of Dairy Industry library, typewritten lists of references were compiled on the following subjects: Electrical Treatment of Milk, 5 pages; Raw Milk Versus Pasteurized Milk, 5 pages; References Relating to Dairying in Cuba and Other Subtropical Countries, 3 pages.

In the Bureau of Entomology and Plant Quarantine library, the Bibliography on the Effect of Light on Insects was brought up to date. Work also was continued on Index 5 to the Literature of American Economic Entomology.

In the Office of Experiment Stations library, the seventh supplement to Department Bulletin 1199, List of Bulletins of the Agricultural Experiment Stations for the Calendar Years 1933 and 1934, compiled by Catherine E. Pennington, was completed and is now in press. The index of periodical articles written by State experiment station workers and published in outside journals was continued. In the past fiscal year there have appeared 1,778 articles in 69 scientific journals and society proceedings, all of which have been indexed. The articles have been currently listed in the 12 issues of Agricultural Library Notes. The current list of extension publications which is prepared in the Office of Experiment Stations library has also appeared regularly in Agricultural Library Notes.

In the Forest Service library the following bibliographies and lists have been compiled and mimeographed:

List of subject headings used in the catalog of the Forest Service library. Revised edition. Also, a general classification of forestry literature as compiled by C. F. Korstian, A. B. Recknagel, John M. Briscoe, 1923. Modified and expanded by the Forest Service. 132 pages. November 1, 1934.

A complete list of Forest Service publications. Revised by the library, United States Forest Service, Washington, D. C. 77 p. February 1935.

Why the prairies are treeless: A selected list of references. 7 pages. August 23, 1934.

Shelterbelts for the prairies: An annotated bibliography of the more important references on shelterbelts and windbreak planting in America with brief abstracts. Compiled by Helen Moore, librarian, and Alice Goen and Alice Stuart, junior foresters, Division of Silvics, United States Forest Service. 21 pages.

Selective logging in the United States. Part I. The cost of logging small-sized trees and logs. Part II. Logging methods under selective logging. Part III. Relation to forestry practices. Prepared by William Mitchell, under the direction of E. N. Munnis, Chief, Division of Silvics, and the staff of the Forest Service library. 41 pages. January 1935.

The most extensive bibliographical undertaking of the Forest Service library was the preparation of the Union List of Forestry Serials in libraries throughout the United States and Canada. The compilation was made from the holdings of the United States Department of Agriculture Library (including all those filed in the main Library and the Forest Service library) supplemented by those listed in the Union List of Serials in the libraries of the United States and Canada. A list of approximately 900 titles was mailed to 129 forestry, agricultural, university, and large public libraries throughout the country, with the request that they check their holdings; 125 libraries responded with checked lists. After compiling these data, a second check list was made up, consisting of citations added by the cooperating libraries. This was then mailed to the same group, returns being asked for by September 1, 1935. The scope of the final compilation is to be, insofar as possible, a complete list of all the periodicals in the field of forestry, including magazines of State, Federal, and independent society and institution publications which have been issued in serial form.

In the Bureau of Plant Industry library a list of Daffodil Literature was prepared by Alice C. Atwood and published in the 1935 Daffodil Yearbook of the American Horticultural Society, pages 83-88. A list of publications containing botanical illustrations was also compiled by Miss Atwood for the supplement to Index Londinensis which is in course of preparation by the Royal Horticultural Society. Work was continued on the Check List of Early Horticultural Literature, described in detail in the report for 1934.

The following current literature lists were continued during the year: Agricultural Economics Literature, prepared by the Bureau of Agricultural Economics library; Agricultural Engineering Current Literature, prepared by the Bureau of Agricultural Engineering library; Cotton Literature, prepared by the library of the Division of Cotton Marketing, Bureau of Agricultural Economics;



Entomology Current Literature, prepared by the Bureau of Entomology and Plant Quarantine library; Forestry Current Literature, prepared by the Forest Service library; and Highways Current Literature, prepared by the Bureau of Public Roads library. The Botany and Agronomy current literature lists were issued by the Bureau of Plant Industry library, as in former years, until the end of 1934. At that time Agronomy Current Literature was discontinued with volume 9 and Botany Current Literature with volume 16. A new series was started January 1, 1935, entitled "Plant Science Literature." This list, which is issued weekly, contains the material formerly indexed in Botany Current Literature in addition to some of the more important contributions in the field of agronomy. Two volumes are to be issued each year. Volume 1 was completed at the end of June 1935. At that time the edition was 1,115 copies, of which about 487 were distributed to Department employees in Washington and the field, 500 to libraries and scientific institutions in the United States, and 128 to scientific institutions abroad.

The publication of Agricultural Library Notes was continued through the year. The total number of pages for the past fiscal year was 505, as compared with 385 pages in the preceding year. The number of copies issued was very largely increased during the year in order to make it possible to send it to State extension offices, as requested by the Extension Service of the Department. The number of addresses on the mailing list is 1,570.

### LEGISLATIVE WORK

In the libraries of the Bureau of Agricultural Economics, the Bureau of Agricultural Engineering, and the Bureau of Public Roads, the legislative work during the year was very heavy. In the Seventy-third Congress, second session, 1,169 bills were introduced which were of interest in the Bureau of Agricultural Economics, and 1,150 bills in the Seventy-fourth Congress, first session. Similarly, during the first session of the Seventy-fourth Congress, 1,036 bills were introduced which were of interest to the Bureau of Public Roads. All of these bills were followed throughout the sessions as they were reported, passed, or vetoed. The progress of the bills was recorded and copies of the bills, hearings, reports, etc., were procured and brought to the attention of the offices in these bureaus to whom they were of special interest.

### EXCHANGES

During the year 974 orders were issued on the Division of Publications for the mailing of Department publications requested by foreign institutions and officials, and by societies and individuals from whom publications are received in exchange. This was an increase of 170 over the number of orders issued during the previous year. The foreign mailing lists in charge of the Library are the following: Libraries List (47 addresses), Technical Bulletins (148 addresses), Farmers' Bulletins (674 addresses), Journal of Agricultural Research (563 addresses), Yearbook (450 addresses), and Monthly List of Publications (1,417 addresses).

### BUREAU AND DIVISION LIBRARIES

A list of the branch libraries in the various bureaus and offices and data in regard to them is given in table 6. Cataloging statistics are included in the paragraph above entitled "Cataloging." Statistics of circulation are given in table 5. Other activities are described in the body of the report under their appropriate headings.

The Bureau of Agricultural Economics library was moved again the past year in October, as it was asked to release a number of rooms to the Mails and Files Division of the Bureau. This necessitated a rearrangement of its collections and its offices. It is now located nearer the south end of wing 4 of the South Building, on the third floor. At the time of the move, it was assigned more space for book stacks in order to make it possible to remove the wooden cases from the tops of the steel stacks. This was necessary in connection with the installation of electric lights in the stacks which were previously unlighted with the exception of the inadequate ceiling lights. Although the library was given more floor space, its holdings were reduced by 1,221 volumes, which were

returned to the main Library. The past year has been one of great activity, as the close connection of the Bureau of Agricultural Economics with the economic activities of emergency agencies has been reflected in the work of the Bureau library. There has also been a growing use of the library by the workers of the Bureau for whom it primarily exists. The work has been carried on along the same lines as in previous years, but one important piece of work in progress which has not been mentioned elsewhere in this report or in previous years, is the reading by the staff of the periodicals and newspapers received in the library (1) to use in the monthly issues of Agricultural Economics Literature and Cotton Literature, (2) to provide a special periodical service to certain Bureau workers who need up-to-date information on a particular subject, (3) to organize current information for quick use in reference and other work, and (4) to keep the library staff alert to the significance of current happenings reported by the newspaper and periodical press. This work is closely connected with the clipping systematically done by the staff and organized under broad headings in a current file. Besides the newspapers read for the clipping service, 362 domestic and foreign periodicals are regularly read by members of the staff for this purpose.

The library of the Bureau of Agricultural Engineering began moving on August 2, 1934, to its new quarters in room 2252 in the second wing, second floor, of the South Building. The move was completed on August 4. Added space was also made available to the library. This closer proximity to the main library has been found a great advantage.

As the Animal Husbandry Division library is located in a temporary wooden building, it was decided, on account of the fire hazard, to transfer the bulk of the collection of herd, flock, and stud books to the main Library in the South Building. Approximately 3,600 volumes were therefore moved in July 1934. These were first shelved in the library of the Bureau of Dairy Industry and later moved to the new stacks of the main Library when these became available in December.

The Bureau of Dairy Industry library, which had been located since February 1925 in rooms 33-34 of the east wing of the Administration Building, was moved on July 12, 1934, to rooms 1066-1070 of the South Building in close proximity to the main Library. The work of the mail and file room of the Bureau of Dairy Industry which was organized by the librarian of the Bureau in October 1924, continued under the supervision of the librarian until July 12, 1934, when this supervision was discontinued. At the time of the moving of the library to the South Building, the photographic files, formerly maintained by the library, were also moved to the mail and file room.

The Bureau of Entomology and Plant Quarantine library started moving on July 9, 1934, to its new quarters in rooms 1417-1431 of the South Building. The move was completed on July 11. The library is now located directly opposite the periodical reading room of the main Library. Since its removal, the library has more convenient and comfortable quarters, and its use has much increased.

The Bureau of Plant Industry library was moved on September 25, 1934, to rooms 1065, 1067, and 1069 of the South Building. The new quarters have proved to be very satisfactory as they adjoin the main Library quarters and are also quite accessible to many of the Bureau's divisions.

From the foregoing paragraphs it will be seen that the branch libraries of the Bureau of Dairy Industry, the Bureau of Entomology and Plant Quarantine, and the Bureau of Plant Industry are now in advantageous locations adjoining the main Library and that they are administered as special reference services for the subject they cover, as was recommended in the report for last year. The Bureau of Agricultural Economics library and the Bureau of Agricultural Engineering library have, however, remained in the quarters of their respective Bureaus. Toward the close of the year the Bureau of Chemistry and Soils decided to return to the main Library the collections which have formerly been filed in the library of the Bureau. It is expected that these will be placed in the stacks, thus bringing together practically all of the chemical collections of the Library, with the exception of those now filed in Fertilizer Investigations. Experience of the past year has seemed to indicate that the advantages in bringing together the various bureau libraries in close proximity to the main Library outweigh the disadvantages and that it has improved the general reference service of the Library.



The problem in regard to the branch library service for the Beltsville Research Center is still to be solved. It is hoped that some special arrangements for a library service to this group will be effected in the coming year.

### LIBRARY QUARTERS

The event in the past year which stands out in the history of the Library is the completion of the library stacks and the removal to them of the Library collections. The stacks were begun the first week in July 1934 and were completed the first week in December 1934. The moving of the collections to the stacks was begun on December 7, the first material to be moved being the files of commercial newspapers which the Library had for the previous year been forced to keep in open wooden cases in the basement corridor where they were exposed to much dust and dirt. The cleaning and moving of these files required 4 days. On December 12 the moving of the main collections was started and was completed by the end of the year, though 2 or 3 weeks longer were required to put the Library in order. This, therefore, is the final chapter in the account of the provision for what will, presumably, be the permanent home of the Library, plans for which were first mentioned in the annual report for 1926. Almost every report since 1901 has, however, called attention to the need for safe, commodious, convenient, and attractive quarters for the Library. The final realization of this hope, with the added comfort of air conditioning in the stacks, is therefore reason for much gratification. The number of square feet provided in the stacks is 39,043, the number occupied by the reference and circulation rooms is 10,802.7, the number occupied by offices is 7,099, and the number occupied by storerooms and locker room is 1,188.5, or a total of 58,133.2 square feet. With its improved quarters the Library should, and it is hoped will, be able to give better service to its clientele.

### LIBRARY STAFF

In the Library, 35 permanent employees were carried on the rolls at the close of the fiscal year, and 73 by the bureau and office libraries, making a total of 108, an increase of 10 as compared with the number in 1934. Of this number, 15 were in administrative positions, including the Librarian of the Department, the heads of divisions in the main Library, and the librarians of the bureaus; 59 were assistant librarians, junior librarians, library assistants, and junior library assistants; 9 were under and minor library assistants; 17 were clerical assistants; and 8 were messengers.

At the annual conference of the American Library Association in Denver in June 1935, the Library was represented by the librarians of the Bureau of Entomology and Plant Quarantine and the Office of Experiment Stations, and an assistant from the Bureau of Agricultural Economics. At this meeting, the librarian of the Office of Experiment Stations served as secretary of the Agricultural libraries section. Louise O. Bercaw, of the Bureau of Agricultural Economics library, continued as chairman of the committee on cooperative bibliographical aid of the Agricultural libraries section. The lists prepared by the committee were published in Rural America, the organ of the American Country Life Association. The Special Libraries Association meeting in Boston in June 1935 was attended by the assistant librarian of the Bureau of Animal Industry and by the assistant in charge of Department publications in the main Library. The librarian of the Bureau of Agricultural Economics gave three addresses under the auspices of the Connecticut Library Committee in May 1935. The Librarian of the Department attended the Conference of Eastern Librarians held at the time of the dedication of the new library building of Columbia University in November 1934.

The report of the past year's work would be most incomplete without acknowledging the loyal and efficient service of the members of the Library staff who have made possible the accomplishments herein recorded.

In conclusion, mention should be made of the death on May 22, 1935, of William Parker Cutter, librarian of the Bermuda Biological Station. Mr. Cutter was librarian of the United States Department of Agriculture from September 1893 to December 1900. His service with the Library was especially noteworthy since it covered the period of reorganization, introduction of modern library methods, and the establishment of the library policies under which the Library has since been operating. He was a librarian of deep and varied scholarship and the Library of the Department owes to him a great debt.

TABLE 5.—Combined statistics of circulation, 1934 and 1935

Bureau or office library	Number of books circulated								Current periodical circulation		Number of borrowers in 1935
	To individuals		To library		To branch libraries		Total				
	1934	1935	1934	1935	1934	1935	1934	1935	1934	1935	
Main Library.....	19,479	22,912	-----	-----	30,918	28,874	50,397	51,786	(1)	(1)	-----
Agricultural Economics.....	18,147	20,998	1,358	1,151	347	324	19,852	22,473	(1)	(1)	897
Division of Cotton Marketing.....	3,697	4,682	(1)	(1)	(1)	(1)	3,697	4,682	26,295	22,342	44
Agricultural Engineering.....	1,672	2,351	201	301	48	82	1,921	2,734	12,016	12,044	75
Animal Industry.....	3,657	3,497	300	265	137	80	4,094	3,842	46,461	46,574	77
Division of Animal Husbandry.....	1,446	1,029	118	102	22	18	1,586	1,149	9,400	10,580	76
Chemistry and Soils.....	6,222	5,428	979	835	80	49	7,281	6,312	47,272	46,262	355
Fertilizer Investigations.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	2,090	2,234	86
Dairy Industry.....	1,948	2,244	133	87	53	54	2,134	2,385	26,763	29,021	73
Entomology and Plant Quarantine.....	3,050	3,540	473	631	-----	-----	3,523	4,171	6,979	10,490	132
Division of Bee Culture.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-----
Experiment Stations.....	1,558	1,646	(1)	(1)	(1)	(1)	1,558	1,646	24,994	28,041	115
Forest Service.....	2,891	3,914	593	728	63	112	3,547	4,754	6,780	8,204	520
Home Economics.....	3,578	2,812	511	422	-----	-----	4,089	3,234	12,958	13,703	73
Plant Industry.....	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	32,982	31,665	(2)
Public Roads.....	3,585	4,426	1,187	1,050	-----	-----	4,772	5,476	8,210	9,815	160
Total.....	70,930	79,479	5,853	5,572	31,668	29,593	108,451	114,644	263,200	270,975	-----

<sup>1</sup> Figures not available.

<sup>2</sup> The Bureau of Plant Industry library does not maintain a collection of books as it is in close proximity to the main Library. The circulation of books to members of the Bureau is therefore included with those for the Library, but circulation figures are available for current periodicals, as this circulation is handled in the Bureau of Plant Industry library.

TABLE 6.—Statistics of Bureau libraries <sup>1</sup>

Bureau or office library	Em- ploy- ees	Books	Pam- phlets	Period- icals cur- rently re- ceived	Regis- tered bor- rowers	Regis- tered bor- rowers to whom period- icals are circu- lated	Shelv- ing	Space occu- pied
	Number	Number	Number	Number	Number	Number	Linear feet	Square feet
Agricultural Economics.....	23	271,833	(3)	2,156	397	158	4,947	6,610
Division of Cotton Marketing.....	4	635	(3)	310	44	44	66	576
Agricultural Engineering.....	1	4,2905	4 8,000	250	75	35	681	1,040
Animal Industry.....	3	(3)	(3)	673	77	75	119	540
Animal Husbandry Division.....	1	5,328	7,074	269	76	46	746	630
Chemistry and Soils.....	3	11,742	(3)	616	355	153	1,770	1,000
Fertilizer Investigations.....	1	4,600	(3)	121	86	50	623	1,260
Dairy Industry.....	2	1,400	5,400	366	73	64	495	639
Entomology and Plant Quarantine.....	3	11,938	14,370	890	132	53	1,943	2,488
Division of Bee Culture.....	1	2,500	750	80	(3)	(3)	342	400
Experiment Stations.....	8	4,566	90,235	1,182	115	66	1,806	2,650
Forest Service.....	6	28,864	-----	245	520	129	1,425	1,564
Home Economics.....	2	4,687	(3)	294	73	51	685	736
Plant Industry.....	10	4 412	750	611	-----	187	140	650
Public Roads.....	4	4 15,328	21,268	336	160	180	1,499	1,559
Solicitor's Office.....	1	4 6,600	-----	(3)	(3)	(3)	1,330	1,214

<sup>1</sup> The Weather Bureau Library is administered separately, with the exception that the books and periodicals are purchased from the appropriation of the Library of the Department, the sum of \$1,000 being set aside each year for this purpose.

<sup>2</sup> Includes pamphlets.<sup>3</sup> Figures not available.<sup>4</sup> Approximate figures.<sup>5</sup> Does not maintain a collection of books.



TABLE 7.—Financial statement, fiscal years 1926-35

## RECEIPTS

Item	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Source:										
Library appropriation:										
Salaries.....	\$38,680.00	\$54,680.00	\$60,000.00	\$69,100.00	\$69,300.00	\$71,860.00	\$74,120.00	\$74,120.00	\$84,998.00	\$67,613.00
General expenses.....	29,500.00	29,500.00	24,180.00	26,580.00	32,700.00	32,700.00	36,500.00	31,980.00	35,225.00	24,074.00
Total.....	68,180.00	84,180.00	84,180.00	95,680.00	102,000.00	104,560.00	110,620.00	106,100.00	120,223.00	91,687.00
Department printing and binding fund.....	9,983.30	13,173.75	10,045.07	8,199.46	10,614.72	13,662.86	25,207.11	19,666.09	22,963.08	17,705.97
Main Library salaries paid by bureaus.....	16,521.50									
Grand total.....	94,684.80	97,353.75	94,225.07	103,879.46	112,614.72	118,222.86	135,827.11	125,766.09	123,216.08	109,392.97

## EXPENDITURES

Books and serials.....	\$14,710.31	\$14,750.47	\$13,093.14	\$14,817.52	\$18,806.78	\$19,971.38	\$19,047.74	\$13,873.16	\$11,423.40	\$12,598.62
Periodicals.....	7,184.29	7,517.97	8,845.99	9,061.06	9,431.94	9,351.98	10,402.63	9,068.76	9,691.34	10,740.87
Maps.....						28.50	8.43	56.30	11.81	1.50
Index cards.....	169.30	137.88	155.41	165.75	149.98	227.68	299.07	188.97	167.80	130.88
Furniture shelving, and miscellaneous equipment.....	404.77	476.86	1,133.24	821.04	1,569.37	898.32	4,019.44	2,806.80	860.65	516.46
Traveling expenses.....		78.44	108.64		29.64	78.87	29.63		40.38	
Freight, express, and trucking service.....	128.09	95.39	107.87	127.97	113.00	125.65	169.42	132.70	86.11	78.62
Supplies.....	474.40	767.00	750.01	707.35	708.47	651.73	944.77	737.62	650.31	455.48
Repairs.....	497.44	355.24	328.99	641.74	962.92	228.64	1,831.78	3,223.09	167.24	244.81
Newspapers.....				809.90	974.91	1,105.50	784.86	815.80	1,094.97	1,167.54
Telephone and telegraph.....								276.86	351.44	374.38
Special and miscellaneous expenses (general char- service and cleaning supplies).....	2,700.00	2,760.00	2,760.00	3,300.00	3,300.00	3,300.00	3,300.00	4,599.98	1,558.10	
Salaries (exclusive of char service).....	40,993.92	56,626.50	56,895.09	65,226.70	65,952.43	68,365.06	69,333.05	70,173.35	59,605.36	65,095.10
Total.....	67,362.12	83,585.75	84,175.78	95,670.03	101,999.44	104,333.31	110,170.82	105,953.48	85,708.91	91,404.26
Printing.....	477.32	327.96	438.95	553.00	349.43	635.79	659.66	897.62	466.09	509.08
Binding.....	9,505.98	12,845.79	9,006.82	7,646.46	10,265.29	13,027.07	24,547.45	18,669.07	22,527.59	17,135.99
Main Library salaries paid by bureaus.....	16,521.50									
Grand total.....	93,866.92	96,739.50	94,220.85	103,878.49	112,614.16	117,996.17	135,377.93	125,620.17	108,702.59	109,110.23
Credit received for duplicates exchanged with book dealers and libraries.....	216.35	653.68	147.30	455.76	335.64	201.96	270.67	98.85	149.85	193.24

TABLE 7.—*Financial statement, fiscal years 1926-35—Continued*  
SUPPLIES AND REPAIRS

Item	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
<b>Supplies:</b>										
Cleaning and toilet.....										
Stationery.....	\$109.31	\$124.22	\$104.76	\$107.62	\$95.07	\$84.34	\$67.10	\$367.62	\$164.00	\$8.56
Miscellaneous office.....	297.85	287.85	107.11	338.97	214.74	248.22	384.71	186.64	137.16	80.30
Binding material.....	291.99	289.02	488.76	294.74	289.19	280.04	391.03	165.95	320.65	315.40
	73.10	95.91	49.38	126.32	109.47	38.13	100.93	17.41	28.50	51.22
<b>Total.....</b>	<b>474.40</b>	<b>767.00</b>	<b>750.01</b>	<b>707.35</b>	<b>708.47</b>	<b>651.73</b>	<b>944.77</b>	<b>737.62</b>	<b>650.31</b>	<b>455.48</b>
<b>Repairs:</b>										
Carpentry work.....	151.52	57.49	65.43	160.74	188.13	68.88	903.72	2,350.24	44.34	78.36
Electrical work.....	43.52	60.04	31.46	107.04	241.12	43.50	27.55	125.00	57.42	17.08
Typewriters.....	86.38	68.00	20.92	37.19	143.43	23.43	36.31	173.39	34.30	9.01
Painting.....	142.88	120.91	135.05	186.59	124.80	14.38	739.29	490.76		
Miscellaneous.....	70.94	68.80	74.13	70.18	383.94	76.43	94.91	167.80	31.12	110.87
<b>Total.....</b>	<b>497.44</b>	<b>355.24</b>	<b>326.99</b>	<b>641.74</b>	<b>962.92</b>	<b>228.64</b>	<b>1,831.78</b>	<b>3,223.09</b>	<b>167.24</b>	<b>215.32</b>



















# REPORT OF THE DIRECTOR OF PERSONNEL, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
OFFICE OF DIRECTOR OF PERSONNEL,  
Washington, D. C., September 18, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: Herewith I submit a report of the work in the Office of Personnel for the fiscal year ended June 30, 1935.

Sincerely yours,

W. W. STOCKBERGER, *Director.*

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## INTRODUCTION

The large additions to the personnel of the Department resulting from emergency activities, and the consequent increase in the volume and complexity of financial and budgetary transactions led to the establishment, at the close of the fiscal year 1934, of two coordinate agencies, the Office of Personnel and the Office of Budget and Finance, in lieu of the former Office of Personnel and Business Administration. This action, which brought the organization of the personnel work of the Department into line with modern views on personnel management, has made it possible to give more consideration to the development of morale and the improvement of human relations within the service.

## TRAINING IN PERSONNEL MANAGEMENT

Responsive to numerous requests from employees for training in personnel work, an experimental course of 10 lectures on the Elements of Personnel Administration, was offered as a part of the educational program of the Graduate School of the Department. The lecturers included outstanding representatives of the field of industrial personnel as well as Government officials. Registrants for the course which was open to all Government employees in Washington numbered 766, of whom 381 were employees of the Department of Agriculture.

In the development of a new organization or the rapid expansion of an existing one, effective operation is often retarded by inability to secure adequately trained personnel. The effectiveness with which an organization can absorb the shock of a sudden, large expansion in personnel depends upon the extent to which the men who are second or third in line have received training in the basic principles of administration in the positions next above their own in responsibility. It is therefore recommended that training in administration and in personnel management be made a part of the permanent program of the Department.

## POST-ENTRY TRAINING

A short period of intensive "training on the job" would yield large dividends especially from employees whose work, to be effective, must produce comparable results, such as estimators, inspectors, cotton classers, and grain graders. In some of our bureaus, notably in the Forest Service and in the Bureau of Agricultural Economics, training programs have been in effect for several years, and the increased effectiveness of the work performed by employees who completed the courses points the way to effect further improvement in the service.

At present we have no recognized procedure for fully acquainting new appointees in the lower grades with the duties they may be called upon to perform. Stenographers, for example, may be assigned to a supervisor who will see that they receive instruction in the objectives of the work, in the organization of the bureau in which they are assigned, and in the minutia of office procedure, or they may be placed at a desk and left to acquire the necessary information as best they can. Provision should be made for an orientation course for such new



appointees. Two hours a week for a period of from 4 to 6 weeks devoted to intensive training should suffice to prepare new appointees for effective service.

Opportunity for advanced training should be provided for older employees, some of whom, after years of service, find themselves in blind-alley jobs, or discover that they are not fitted for the work to which they are assigned. For such employees our system of assignment should be expanded and made more flexible in order to provide more employees with the job for which they are best fitted and which carries with it an opportunity for advancement. Such a procedure, it is believed, will materially decrease the so-called "personnel" problems in many of the bureaus.

### APPOINTMENTS, SEPARATIONS, AND PROMOTIONS

On June 30, 1935, there were 44,080 persons under appointment in the Department, as compared with 38,623 at the close of the fiscal year 1934, an increase of 5,457 employees. The Agricultural Adjustment Administration increased its force from 5,152 to 6,136 during the fiscal year, a net gain of 984 employees. The emergency appropriations from the Public Works Administration and for the emergency conservation work were continued through the year. On March 25, 1935, the Soil Conservation Service with its 1,272 employees was transferred from the Department of the Interior to this Department, and by June 30, 1935, the number of employees in that Service had increased to 1,853. On June 1, 1935, 1,670 employees of the Agricultural Adjustment Administration were transferred to the Resettlement Administration. Personnel data for the last 5 years are shown in table 1.

TABLE 1.—*Personnel activities of the Department of Agriculture, 1931, 1932, 1933, 1934, and 1935*

Year ended June 30—	Employees on rolls of Department			Field stations	Employees appointed	Separations from the Department
	Departmental service	Field service	Total			
1931.....	5,639	22,524	28,163	1,451	10,258	7,836
1932.....	5,664	<sup>1</sup> 21,764	27,428	1,451	6,612	7,425
1933.....	5,521	<sup>2</sup> 21,023	26,544	1,451	3,915	4,721
1934.....	10,032	<sup>3</sup> 28,591	38,623	1,451	<sup>4</sup> 31,434	<sup>5</sup> 19,355
1935.....	11,437	<sup>6</sup> 32,643	44,080	1,864	<sup>7</sup> 29,092	7 23,635

<sup>1</sup> Includes 78 in Foreign Service.

<sup>2</sup> Includes 80 in Foreign Service.

<sup>3</sup> Includes 11,667 in Agricultural Adjustment Administration.

<sup>4</sup> Includes 6,647 in Agricultural Adjustment Administration.

<sup>5</sup> Includes 52 in Foreign Service.

<sup>6</sup> Includes 8,249 in Agricultural Adjustment Administration.

<sup>7</sup> Includes 7,456 in Agricultural Adjustment Administration.

On June 30, 1935, there were 1,072 collaborators serving without compensation, who are not included in the above figures. The largest number of employees in the Department during the World War period was 25,239 on July 1, 1918. The present force of 44,080 shows a gain over that period of 18,841 employees, or 75 percent.

The turn-over of permanent employees during the year was 7.19 percent, as compared with 10.63 percent during the fiscal year 1934; 3.88 percent during 1933; 5.98 percent during 1932; and 7.95 percent during 1931. The apparent decrease in the turn-over during the year as compared with 1934 is accounted for by the fact that during the fiscal year 1934 employees appointed regularly from civil-service certificates for a probationary period for the duration of the work were counted as permanent in 1934, whereas during 1935 they were counted as temporary or emergency employees.

The number of persons appointed during the year was 29,092, and the number separated 23,635, as compared with 31,434 appointments and 19,355 separations during 1934. In both of these years, owing to the establishment of the Agricultural Adjustment Administration and other emergency offices, there was an abnormally large number of appointments and separations as compared with previous years.

The number of persons promoted during the year was 3,764, as compared to 914 promoted during 1934. Of this number, 1,470 were in the Agricultural Adjustment Administration. The so-called "administrative promotions", i. e., promotions within the grade, were still prohibited during the year by the Economy Act of June 30, 1932. These promotions are accounted for principally by changes of assignments incident to filling vacancies in the higher grades.

Under a requirement of the Economy Act authority was obtained from the President to fill 6,024 positions in the Department of Agriculture during the year.

During the year 410 formal applications for civil-service positions were received and circulated throughout the Department, as compared with 254 during 1934.

### RECORD OF LEAVE

During the calendar year 1933, the legislative furlough was in effect until March 31, 1933. Beginning April 1, annual leave was restored at the rate of 15 days per annum. As annual leave was not allowed for the full year, no statistics were compiled. However, statistics for sick leave for the calendar year 1933 have been compiled. As indicated in last year's report the decrease of the amount of annual leave to 15 days did not materially affect the amount of sick leave taken by the employees of the Department. In fact, during the calendar year 1933 the amount of sick leave taken by employees in Washington was slightly less than the 8-year average, the average for 1933 being 7.3 days, whereas the 8-year average was 7.5 days.

In the field where the limit of sick leave was 15 days, the average sick leave taken during the year 1933 was also less than the 8-year average, being 2.7 days for 1933, while the 8-year average ended with December 31, 1933, was 3 days.

Though it is commonly reported that Government employees in Washington take 30 days sick leave each year, the records show that during the calendar year 1933 only 4.9 percent of the employees in Washington took the maximum amount, while 27 percent of the employees did not take any sick leave. In the field for the calendar year 1933 only 4.5 percent took the maximum amount, and 50 percent took none. The 8-year average of employees taking the full amount of sick leave is 5.5 percent for Washington and 6.4 percent for the field, while 27 percent of the employees in Washington and 52 percent of the field force used no sick leave.

### WORK INCIDENT TO APPOINTMENTS, TRANSFERS, AND PROMOTIONS

Personnel changes in the Department necessitated contacts with the Civil Service Commission, and certificates and authorizations were obtained as indicated in table 2.

TABLE 2.—*Personnel changes in the Department of Agriculture, 1931, 1932, 1933, 1934, and 1935*

Item	1931	1932	1933	1934	1935
Certificates from register.....	1,420	702	74	1,510	1,648
Reinstatement certificates.....	385	212	27	481	416
Certificates for change in status.....	619	194	108	254	910
Transfer certificates.....	289	165	69	465	220
Authorities for temporary appointments.....	762	462	94	4,848	740
Authorities for extensions of temporary appointments.....	432	443	66	4,031	1,466
Authorities for extensions of suspensions.....	11	6	6	3	2
Civil-service examinations requested.....	132	26	7	29	110

### RETIREMENT RECORDS

During the past year 205 employees were retired in accordance with the Retirement Act.

Figures showing retirements for the past 5 years are shown in table 3, and the average annuities paid in the various groups are shown in table 4.

TABLE 3.—*Number of employees retired, 1931, 1932, 1933, 1934, and 1935*

Year ended June 30—	Annuity retirements in class				Disability retirements in class				Cases disposed of
	Professional	Sub-professional	Clerical, administrative, and fiscal	Custodial	Professional	Sub-professional	Clerical, administrative, and fiscal	Custodial	
1931.....	36	88	20	27	7	17	20	3	<sup>1</sup> 218
1932.....	22	41	13	9	8	17	8	10	<sup>1</sup> 128
1933.....	81	132	22	28	9	23	19	15	329
1934.....	51	63	58	24	12	12	28	11	259
1935.....	46	65	24	12	10	14	29	5	205

<sup>1</sup> Corrected figure.TABLE 4.—*Averages of the annuities in the various groups, 1931, 1932, 1933, 1934, and 1935*

Group	1931	1932	1933	1934	1935
Professional and scientific.....	\$1,006.77	\$1,100.77	\$1,114.04	\$1,102.22	\$1,039.81
Subprofessional.....	926.61	972.67	1,012.91	946.81	960.08
Clerical, administrative, and fiscal.....	907.88	981.88	963.67	946.83	826.35
Custodial.....	749.42	698.57	695.98	757.72	728.50

Since the requirement in section 204 of the Economy Act that exemptions from compulsory retirement must be approved by the President, extensions in the service upon reaching the age for retirement were limited to one associate economic geologist in the Bureau of Public Roads, who received a continuance in the service for 1 year. A senior pathologist in the Bureau of Plant Industry, and a principal soil scientist in the Bureau of Chemistry and Soils, who were granted continuances in the service in previous years, were granted further extensions for 1 year during the fiscal year.

In addition to the above, the retirement section forwarded to the Civil Service Commission 1,188 applications for refund of retirement deductions, 85 applications for accumulated deductions (death claims), and 1,442 of the Civil Service Commission Master Retirement Record Card No. 2806 for employees who resigned, transferred to other establishments, or separated for other reasons.

There were 183 employees who obtained credit for past temporary or excepted service as provided for under section 9 of the act of May 29, 1930, and redeposited the amounts previously refunded.

There should be established as soon as practicable a follow-up system on probationers. Under the procedure now in effect a person appointed in the professional service from a civil-service certificate serves a probationary period of 1 year. In the clerical, administrative and fiscal, the subprofessional, and the custodial services the period of probation is 6 months. The existing requirement is a report from the chief of the bureau 1 month before the expiration of the probationary period, certifying to the probationer's service during the period of 11 or 5 months, respectively. If the report is satisfactory, he is retained; but if unsatisfactory, he must be transferred to another assignment or separated from the service. If administrative officers were required at frequent intervals to scrutinize and report upon the probationer's efficiency and fitness for the service, the single and too frequently perfunctory report would be replaced by a definite determination of ability to do the work required.

## INVESTIGATIONS

An unpleasant but necessary part of personnel administration is the investigation of cases involving irregularities or misconduct on the part of employees. This task is assigned to a chief investigator who with assistants conducts investigations both in Washington and the field, and upon request of the bureaus also investigates cases of alleged violations of the various regulatory laws which are administered by the Department; makes periodical inspections of field offices;



reviews and analyzes reports containing recommendations for disciplinary action submitted by the various bureaus; prepares for the consideration or signature of the Secretary, briefs of such cases, letters of charges, decisions, reprimands, and correspondence relative thereto, and reviews such correspondence when prepared in the bureaus.

### CLASSIFICATION OF POSITIONS

During the fiscal year the work of classification, required by the Classification Act of 1923, as amended, nearly equaled in volume that of the previous year. The continuation of emergency allotments, the transfer of the Soil Conservation Service from the Department of the Interior, and the reorganization of certain lines of work in the various bureaus have occasioned a large part of the classification work required.

A summary of this activity, insofar as it relates to the personnel in Washington, for the past 5 years is given in table 5.

TABLE 5.—*Appointments and changes in status of employees of the Department of Agriculture, 1931, 1932, 1933, 1934, and 1935*

Year ended June 30—	Appoint- ments to new positions	Changes in duties	Changes to vacancies	Appeals	Total
1931.....	545	430	979	110	2,064
1932.....	187	320	725	23	1,255
1933.....	246	143	104	5	498
1934.....	5,561	1,274	2,329	15	9,179
1935.....	1,634	3,315	3,260	45	8,254

In addition to the above, and in anticipation of the time when classification may be extended to the field service, tentative classifications of all permanent, new positions created in the field were reviewed and aligned with departmental standards; also thousands of positions of employees who were paid from emergency funds were classified in accordance with the requirements of Executive Order No. 6746, dated June 1, 1934.

Charts showing the organization of the various bureaus and offices in the Department were prepared at the request of the Emergency Council, at which time standardization was effected in the terminology of the administrative subdivisions within the bureaus, and a revision begun of obsolete descriptions of work, which is still in progress.

### EMPLOYEE ACTIVITIES

The Office of Personnel has sponsored the establishment of various welfare and recreational activities, and has encouraged the voluntary formation of groups of employees with a view to working out cooperative plans for their mutual advantage and satisfaction. Some outstanding examples of these activities are:

The Welfare Association, a self-sustaining organization which makes non-interest-bearing loans to employees in need, operates a cafeteria and a store, employs a full-time welfare worker, and contributes to the support of the other activities.

In 1934, 10,783 policies were in force in the group insurance, which represented \$10,927,750 of insurance. Eighty death and disability claims, amounting to \$59,500 were paid during the year. The surplus or reserve fund was \$154,453.

The recently formed Credit Union has 500 members and has outstanding loans to employees in excess of \$12,000.

Over 2,000 employees of the Department are participants in a hospital-service plan, which at a cost of 75 cents a month, provides 21 days of hospital care in any one contract year.

The medical and health committee was formed to investigate the advisability of establishing a cooperative organization to secure medical diagnosis for its members and medical service as well.

The functions of the rent and housing committee are to aid new employees to find satisfactory housing, to investigate the possibility for a cooperative apartment house for employees of the Department, and to organize a community project for the cooperative erection of individual homes at a moderate cost. A site in

Virginia within a few minutes' drive of the Department has been selected, and construction of the first group of homes is under way.

The Musical and Dramatic Guild was formed by employees "interested in music and the drama and desiring to express that interest in good fellowship." The activities of the guild are carried out through three major groups, choral, dramatic, and orchestral. During the year these groups cooperated in 12 presentations, open to employees, at which the total attendance exceeded 4,000.

The Athletic and Recreational Association was formed to promote and foster athletic and recreational activities among our employees. Sections have been formed according to diversity of interest, ranging from aviation and baseball to chess and pitching horseshoes. It is estimated that upwards of 2,000 employees are active participants in the various activities of the association.













# REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
*Washington, D. C., August 31, 1935.*

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1935.

Sincerely yours,

FREDERICK D. RICHEY, *Chief.*

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## INTRODUCTION

Properly to fulfill its function, research must be relatively continuous in plan and execution. Undue modification to meet ever-shifting needs results only in fragmentary accomplishment in any direction with a minimum of value to anyone. Research prosecuted to successful solutions, on the other hand, builds a cumulative store of information upon which to draw when need arises. The value of such a research program by the Bureau of Plant Industry upon problems related to crop production has been continuously demonstrated through the recent years of agricultural adjustment. Information has been available as to the kinds and varieties of field and horticultural crop plants that were suited for different purposes in different localities. Of nearly equal importance, it has been possible to discourage unwarranted expansion of some crops and thereby avoid heavy losses to farmers and investors, certain otherwise to have followed. Plants previously introduced and tested by the Bureau have been of important value in the soil-conservation and back-to-grass programs. The earlier solutions of certain forest-tree nursery disease problems were available as a basis for reducing losses in connection with the expanded programs of shelter-belt planting and reforestation. Finally, the increased efficiency of production, the avoidance of losses in field and storage, and the more economical methods of transportation and storage made possible by various phases of the Bureau's research have benefited all classes of the population.

In the light of these facts, the program of the Bureau has been continued during the past year along much the same lines as previously. This does not mean, however, that the program was static. Additional emphasis was placed here and there on phases of special importance in connection with current tendencies, and some new projects were undertaken bearing on newly arisen problems. Some of the high lights of the year's accomplishments are shown in the following pages. A complete picture of what the Bureau does can be had through the 548 publications emanating from the Bureau during the year and listed herewith.

## CHANGES IN ORGANIZATION AND PERSONNEL

Various changes in organization and personnel occurred during the year. On September 1, 1934, the Division of Soil Fertility Investigations and the Division of Soil Microbiology were returned to this Bureau by transfer from the Bureau of Chemistry and Soils. On April 15, 1935, responsibility for

research in the technological phases of fruit and vegetable utilization was transferred to the Bureau of Chemistry and Soils, and on the same date the soil-erosion nurseries were transferred to the newly organized Soil Conservation Service.

During the year the Bureau suffered the loss, through retirement, of five of its eminent scientists: Merton B. Waite, Cornelius L. Shear, Edmund C. Shorey, William Stuart, and David Fairchild. These men were pioneers in plant research in the Government and, through notable contributions during their long and productive careers, had become recognized leaders in their respective fields.

On October 23, 1934, Frederick D. Richey, formerly associate chief, was appointed chief of the Bureau, vice Knowles A. Ryerson, who assumed charge of subtropical horticultural research in the Division of Fruit and Vegetable Crops and Diseases. Coincidentally, M. A. McCall and E. C. Auchter were appointed assistant chiefs, while continuing in charge of their respective divisions, and H. E. Allanson was made business manager of the Bureau. On January 2, 1935, Henry W. Barre, formerly director of the South Carolina Agricultural Experiment Station, was appointed principal pathologist in charge of the Division of Cotton and Other Fiber Crops and Diseases. Upon the retirement of Cornelius L. Shear, noted above, H. A. Edson was appointed in charge of the Division of Mycology and Disease Survey.

### WORK UNDER SPECIAL ALLOTMENTS

On July 1, 1934, there remained available for expenditure from the original allotments made by the Public Works Administration to the Bureau of Plant Industry during the preceding fiscal year the following balances: For agronomic studies of crops furnishing nonpoisonous spray materials, \$33,641; for the National Arboretum, \$10,747; for the improvement of the physical plant of the Bureau throughout the field, \$630,680; for work in connection with the establishment of shelter belts in the Plains region, \$11,500. Work done on these projects is reported under the headings of the divisions concerned. These special allotments were an important aid in the projects mentioned and in improving the Bureau's facilities for research.

### CEREAL CROPS AND DISEASES

M. A. MCCALL, *in charge*

Better producing varieties of the standard cereal crops, more resistant to disease, drought, cold, and other adverse factors, are essential to any satisfactory solution of the problems facing American agriculture and its stabilization. The removal of hazards and the improvement of crop quality have been and continue to be the primary objectives of the research program.

#### CEREAL SEED SUPPLIES

The severe drought of 1934 threatened a serious shortage in adequate seed supplies of the best improved varieties of the standard cereal crops. In cooperation with the Agricultural Adjustment Administration, the Bureau of Plant Industry assisted in locating, purchasing, cleaning, and distributing seed supplies of the standard crops as part of a national emergency conservation program. There were made available to farmers for sowing 5,050,000 bushels of spring wheat, 1,150,000 bushels of durum wheat, 9,500,000 bushels of oats, 1,700,000 bushels of barley, 28,000 bushels of grain sorghum, and 400,000 bushels of flax. This was a most important project in the program to improve and standardize American feed crops. It prevented the loss of, or at least the serious reduction in, valuable seed supplies of the best adapted varieties, and made available to growers throughout the entire drought-affected area a quality of seed that could not otherwise have been obtained.

#### CORN

Yield comparisons of corn in Iowa, Illinois, Indiana, and Ohio showed that hybrids which have been developed in the cooperative breeding program in these States withstood the drought better than the standard open-pollinated varieties. In each State the hybrids produced larger percentage increases



over the varieties in 1934 under severe drought conditions than in 1933 under favorable conditions.

In cooperation with the Bureau of Entomology and Plant Quarantine it was discovered during 1934-35 that the organism *Aplanobacter stewarti*, causing bacterial wilt of corn, overwinters in adults of the flea beetle, *Chaetocnema pulicaria*, and that primary infections are carried to young corn by this insect.

#### WHEAT

In the cooperative wheat-improvement program, emphasis is being placed on improvement in quality, disease resistance, lodging, winter-killing, and yield.

The Cheyenne variety, a selection from Crimean hard winter wheat made at the Nebraska Agricultural Experiment Station, is now being grown on farms in that State. Besides being high yielding, it is resistant to shattering and is winter-hardy and stiff-strawed. It is being received by Nebraska farmers enthusiastically. There has been some question regarding its baking quality, but recent experiments indicate that extending the mixing period produces a loaf of good quality.

The Thatcher variety, bred in cooperative experiments at the Minnesota station, was distributed for commercial growing in that State during the current year. It produces well, is of excellent milling and baking quality, and is resistant to stem rust.

The Ceres variety, bred at the North Dakota station for resistance to stem rust, is of satisfactory yield and quality and has rapidly gained in popularity, over 5,000,000 acres being grown in 1934.

In the western area where stinking smut (bunt) is the most serious problem in wheat production, marked progress has been made in the development of smut-resistant varieties. The variety Relief in Utah, and Rex, Oro, Rio, Albit, and Redit in Oregon, Washington, and Idaho, resistant to several forms of stinking smut, are increasing in acreage and are exerting a definite influence in reducing smut infestation.

#### OATS

The oat-breeding program of the Bureau, in cooperation with the various State experiment stations, is centering on the production of new high-yielding varieties resistant to the smuts and to stem and crown rusts. Marked progress is being made, and new varieties will shortly be available for distribution through cooperating stations.

The drought was a material handicap in this program, particularly in the Corn Belt, where practically no oat crop was obtained. Fortunately, through cooperative relationships, remnant seed of many lines was sown under irrigation at the Aberdeen Substation, Aberdeen, Idaho, which otherwise would have been lost, so that seed was available for sowing on Corn Belt stations in the spring of 1935. This emphasizes the advantages accruing both to the Department and to the State stations from cooperation in the breeding and improvement of cereal crops.

#### BARLEY

With the return of an important cash market for malting barley, there is renewed emphasis on the necessity for considering malting quality in the production of this crop. The relationships of variety, locality, cultural and handling practices, and disease to production of high yields and to malting quality are being studied.

#### RICE

Fortuna and Rexoro rices, of superior culinary qualities, developed in cooperation with the Louisiana station, were grown on a larger acreage in Louisiana and Texas in 1934 than in previous years, the two varieties occupying approximately 31,000 acres. Based on maximum producers' prices, these varieties are valued at 70 and 75 cents per barrel more than Early Prolific, and 30 and 35 cents more than Blue Rose. The acre yields of the four varieties were about the same in 1934. From the acreage sown to Fortuna and Rexoro, the increase paid to growers over an equal acreage of Early Prolific and Blue Rose, therefore, was approximately \$280,000 and \$125,000, respectively.

Progress was made in the breeding of disease-resistant rice varieties. Selections from crosses of the resistant varieties Aikoku and Kameji with commercial varieties show marked resistance to helminthosporium leaf spot and



trichoderma sheath spot. The relationship of rice diseases to reduced yield and quality is little understood by growers. Significant increases in stand and yield were obtained from seed of five varieties of rice treated with ethyl mercury phosphate in cooperative experiments at Crowley, La., and Stuttgart, Ark., in 1934.

Stem rot of rice, causing serious damage in Arkansas, can be controlled most effectively by draining the land at the time the rice is in the boot. Thereafter the soil should be kept muddy, but not submerged until the crop is ready to drain prior to harvest.

#### GRAIN SORGHUMS

The drought of 1934 caused a serious shortage of seed of most of the desirable sorghum varieties in the southern Great Plains, and as a result much inferior seed was sown in 1935. Several new early maturing hybrid varieties were able to produce a partial seed crop in experimental tests despite the drought.

Wheatland milo, a dwarf erect-headed variety developed at the Woodward, Okla., field station and distributed in 1931, continues to be the most productive grain sorghum bred for adaptability to harvesting with the combine.

Early Kalo, developed in cooperative experiments at the Fort Hays, Kans., station, a kafir-milo hybrid, produces good yields from planting as late as July. It appears to have considerable promise for late planting on farms where other crops have failed to produce a stand or where planting has been unduly delayed by unfavorable weather conditions.

Selections from a hybrid between Spur feterita and Blackhull kafir show high resistance to smut in cooperative tests at the Kansas Agricultural Experiment Station. This suggests the possibility of obtaining a strain of kafir resistant to smut. Strains have been isolated from crosses between darso and white-seeded kafir which are similar to darso except that they have white seed free from the bitter taste accompanying the brown seed color of this variety. Darso is well adapted to certain sections of Oklahoma and adjacent territory.

#### SEED FLAX

The drought resulted in a serious reduction in the production of flaxseed in the United States in 1934. Extremely low prices during 1932 and 1933 also were in part responsible for the low production.

The irrigated Southwest is becoming a factor in flaxseed production, largely because of the superior yield of a variety (Punjab, C. I. 20) adapted to the exceptional conditions of the Imperial Valley of California. In 1934, 242,000 bushels were harvested from 11,000 acres in the Imperial Valley, the average yield being 22 bushels per acre. Punjab was introduced by the Bureau of Plant Industry from India in 1913, and its value was shown through cooperative experiments at the California field station in the Imperial Valley. The crop of this variety to be harvested in 1935, totaling about 40,000 acres, is descended from 12 grams of seed sown in a flax nursery at the Imperial Valley station in 1927.

### COTTON AND OTHER FIBER CROPS AND DISEASES

H. W. BARRE, *in charge*

The growing of cotton fiber of better and more uniform quality has become increasingly important under the Department's program of adjusting production to market conditions, and the Bureau's work on cotton has had a definite bearing on this problem. Special study has been given to improved varieties, regional adaptation, cultural methods, disease control, and community cooperation in growing a single superior variety. Fiber flax has also received some attention.

#### COTTON

##### IMPROVED VARIETIES

Two outstanding varieties of upland cotton developed by the Bureau—Acala and Lone Star—continue to give excellent results in the regions in which they are grown. A long-staple selection out of Acala called Tidewater, with 1¼-inch staple, has shown excellent results in field plantings near Charleston, S. C.

Because of its high yield and marked tendency to resist the wilt disease, Tide-water promises to be a valuable addition to the series of varieties being grown in the long-staple areas of the eastern and central Cotton Belt.

Basic stocks of seed of several improved and promising varieties and strains of upland cotton are also being maintained, in the event that special interest should develop in cottons with staple of their respective lengths and qualities.

Because of the important relation of fineness of fiber to yarn strength and quality, studies are being made of this character in the upland cottons. In 1934 a cross was made between the Acala variety and Hopi, a peculiar small-boll variety grown, probably for centuries, by the Hopi Indians in northern Arizona. The fiber of Hopi is about fifteen-sixteenths of an inch long and is reported to be finer than any other short-linted cotton. The objective of the cross is to develop a variety similar to Acala in type of plant, size of bolls, and lint length, but approaching Hopi in fineness of fiber.

Reports on the S X P 30 variety of American-Egyptian cotton were received from seven mills in the United States that have tested it, and all but one expressed the opinion that for most purposes the new variety is superior to the Pima variety, producing a stronger yarn. Several of these manufacturers thought that the new variety could be substituted satisfactorily for the Sakel cotton that is imported from Egypt. Favorable comments on samples were received by the Bureau of Agricultural Economics from several European manufacturers and cotton merchants. On the basis of the results of the spinning tests and of 11 yield tests in comparison with Pima, authorization was given for plantings in 1935 aggregating nearly 2,000 acres, in parts of the Salt River Valley remote from large acreages of Pima cotton.

Other promising strains of Egyptian cotton with desirable yields and fiber qualities are being bred and tested for the special conditions of the irrigated valleys.

#### COLLECTION OF COTTON SPECIES

The collections of living plants of numerous species and varieties of wild and cultivated cottons and cotton relatives from many parts of the world, at Riverside, Palm Springs, and Torrey Pines, Calif., have supplied material for cytogenetic investigations which, it is hoped, will ultimately throw light on the origin and classification of the cultivated cottons. In order to obtain material for these studies it has been necessary to develop special methods of hybridization, vegetative propagation, and seed germination, and also of frost protection of the plants so as to preserve them as perennials.

#### REGIONAL VARIETY TESTS

In part with funds provided by the Textile Foundation, a series of regional cotton-variety tests was conducted in 1934 under the coordinating supervision of the Bureau of Plant Industry and in close cooperation with the State experiment stations in North Carolina, Georgia, Tennessee, Arkansas, Oklahoma, and Texas. Groups of 16 of the more popular and promising varieties and strains were grown under a wide range of soil and seasonal conditions. The detailed information obtained from such broader regional tests will supplement similar data from the more localized tests conducted by the State stations and greatly expedite positive and basic determinations of cultural qualifications, adaptability, and effect of environmental conditions on plant and fiber characters of the different varieties. The extreme drought in the western part of the belt severely damaged several of the plantings, but much information was obtained on growth behavior and many samples were collected for laboratory studies. It is too early to report results in full, but sufficient information has been obtained to indicate that regional testing promises to be of great potential value to breeders, growers, and manufacturers. Additional funds provided by the Textile Foundation in 1935 have made it possible to continue the studies on a wider and more comprehensive scale. Similar regional variety experiments are being conducted over a 3-year period in four representative locations in the irrigated valleys of New Mexico, Arizona, and California.

The first of a series of tests of new strains of cotton was begun at Stoneville, Miss., as a basis for further studies of fiber quality and methods by which fiber technology can be utilized in plant breeding, and to obtain other agronomic data on plant growth, fruiting behavior, yields, etc.



## ONE-VARIETY COMMUNITIES

Substantial progress was made during the year in the establishment of single-variety cotton communities. In cooperation with State experiment stations, extension services, vocational teachers, agricultural leaders, ginneries, oil mills, merchants, bankers, manufacturers, and others, the number of such communities completely organized or in various stages of development has reached a total of 200, with an estimated acreage of 800,000. From this acreage there should be produced around 500,000 bales of high-quality cotton, the bulk of which should be available in large, uniform lots running from 1 to 1½ inches in staple length. The most notable developments in community cotton improvement have been in Georgia, Mississippi, and Texas. In these States cotton growers are rapidly becoming quality conscious and are appreciating more and more the great social and economic value of the plan of cooperative production, not only as applied to cotton, but to other agricultural crops and farm operations in the community.

## DISEASES AND DISORDERS

In continued studies of the cotton root rot fungus it was discovered that the majority of the ammoniacal forms of nitrogen, when supplied to Dugger's solution even in as low proportion as 2.8 grams per liter, were unfavorable for growth of the fungus. Especially was this true of ammonium phosphate and ammonium sulphate. Further studies of the toxic effect of ammonia on the fungus show that the mycelia in sectional agar blocks are killed with ammonia water after 24 hours with a concentration of 50 parts per million, and the sclerotia from soil cultures 2 years old are killed in 1 hour with a concentration of 300 p. p. m. It was found that soil moisture is an important factor in maintaining the viability of sclerotia, and that sclerotia remain practically 100 percent viable when kept in cans of moistened soil for a period of 2 years.

Preliminary tests at Greenville, Tex., during 1933 and 1934 indicate that deep tillage may be of definite value in root rot control in northeastern Texas, where the fungus is not so deep seated. Where the soil has been worked and exposed to depths of 12 to 24 inches, promising results have been obtained. Heavy applications of ammonium phosphate show greatest promise of any of the different fertilizers used in Texas. On the blackland soils of Texas heavy applications of organic manures have resulted in increased yields but not in appreciable reduction of root rot. On the other hand, an experiment conducted since 1921, at Sacaton, Ariz., on control of this disease by organic manures applied in deep furrows, continued to demonstrate the efficacy of this method under Arizona conditions. Control of the disease appears to be due to an increase in the soil microflora creating conditions temporarily unfavorable for the root rot fungus.

## FIBER FLAX

General conclusions cannot be drawn from the results of the experimental plots of fiber flax grown in the South Atlantic States in cooperation with the Textile Foundation in 1934, because of the abnormally dry weather in April and early May from central North Carolina to southern Georgia. Certain facts, however, were indicated very clearly: (1) Fiber flax does not grow well on Norfolk sandy soils deficient in organic matter; (2) it grows better after soybeans than after cotton; (3) the flax in the Piedmont region, the Eastern Shore of Virginia, and on the blackland of eastern North Carolina, where temperatures were lower and showers more frequent, made a much better growth than in the sandy Coastal Plain; (4) weeds caused serious loss in plots harvested after the first of July; (5) grain binders are not satisfactory for harvesting fiber flax; and (6) pulling by hand is too expensive to be practical.

## HEMP

Hemp-breeding work, carried on by the Bureau for more than 20 years, was discontinued in 1933, but practical results are still evident in commercial fields. A hemp grower in Kentucky reported a yield of 1,750 pounds per acre of clean dew-retted fiber from 100 acres of the pedigree variety Chinamington grown in 1934. This is more than twice the average yield obtained from ordinary unselected hemp seed.



## DRUG AND RELATED PLANTS

W. W. STOCKBERGER, *in charge*

Efforts have been made to meet the continued demands from some of the new Government agencies and from individuals for information and advice as to plants yielding drugs, essential oils, perfumes, insecticides, etc., in the search for promising new crops. The Bureau's attitude has been not to encourage the growing of these special crops except where there was a reasonable prospect of success.

## INSECTICIDE PLANTS

Much attention was given to an investigation of insecticide plants, particularly pyrethrum and devil's shoestring (*Cracca virginiana*). Interest in plant insecticides that may be grown in this country and thus provide a domestic source of harmless substitutes for chemical insecticides that are poisonous to man and animal has been greatly stimulated by the governmental requirements with respect to the removal of spray residues. A project involving research on the possibilities of growing devil's shoestring was initiated last year through a Public Works Administration allotment. A similar project with respect to pyrethrum, under way for some time, has been greatly elaborated. Cooperative test plots have been established in 15 localities at Bureau field stations, State experiment stations, and subsistence homestead projects. The first crops of flowers, harvested in the early summer of 1935, are being examined chemically and biologically to determine their toxicity to insects. Data on the yield of flowers under the varying conditions obtaining in the widely scattered regions are also being collected, but a real indication of what may be expected from such a crop in any one of the localities will not be obtained until several successive crops of flowers have been harvested.

It is generally recognized that an economic method of harvesting the flowers must be developed if production costs are to be kept at a reasonable limit. Hand-picking methods such as are used in foreign countries require too much labor to make them practicable here unless the crop is grown for the purpose of providing an outlet for labor available in families without cost where such labor is not otherwise employable. In cooperation with the Division of Farm Equipment of the Bureau of Agricultural Engineering a study of the practicability of a number of available farm implements for harvesting such crops was made. Experiments indicate that under certain conditions a grain harvester with minor modifications can be used, and preliminary trials suggest that with certain alterations a cotton stripper may be practicable for the purpose.

As a beginning in the development of desirable types of the pyrethrum plant with regard to both its productivity and the toxicity of the flowers, a 2-acre plot has been established at the United States Plant Field Station, Glenn Dale, Md.

## HOP DISEASES

Special attention was given to downy mildew, which continues to be the most important disease problem to growers of hops. During the 1934 season the disease appeared in many of the hop yards in Sonoma, Mendocino, and Lake Counties, Calif. In the early summer of 1935 it was also found in Sacramento, Yolo, and Yuba Counties of that State, but in this general region climatic conditions do not favor its development. After several years of close observation it may now be stated that none of the commercial varieties grown on the coast is immune to the disease. Early Clusters and Late Clusters, which are the most extensively grown varieties, are highly susceptible. Fuggles and Red Vine, of minor importance commercially, show some resistance, but both are subject to severe damage when climatic conditions favor the disease.

It is increasingly evident that the most promise of permanent control lies in the development of new varieties. Attempts in that direction were continued, and several seedling plants show considerable promise from the standpoint of mildew resistance and other desirable characters.

## DRY LAND AGRICULTURE

C. E. LEIGHTY, *in charge*

### SHELTER BELTS

Investigations were begun by the Bureau at the Northern Great Plains Field Station, Mandan, N. Dak., in 1914 to determine the possibilities of growing trees to provide shelter to farm buildings, orchards, and gardens from damaging winds and drifting snow. Incidental to these, 18 native and introduced species of broad-leaf trees were planted experimentally in 1915, 1916, and 1917 for testing their hardiness and to determine the most favorable distances and methods of growing shelter-belt trees in this area. Of the 18 species only 6 have maintained satisfactory stands and growth to the end of 1934. These are: Chinese elm (*Ulmus pumila*), green ash (*Fraxinus pennsylvanica lanceolata*), chokecherry (*Prunus virginiana*), boxelder (*Acer negundo*), Siberian pea-tree (*Caragana arborescens*), and buffaloberry (*Lepargyrea argentea*). American plum (*Prunus americana*) may be included if planted in rows adjacent to species without spreading, side-branching characteristics. The results of these tests seem to warrant the inclusion of these 6 or 7 species in shelter belts in the northern Great Plains region under dry-land conditions.

### DROUGHT CONDITIONS AND CULTURAL METHODS

The extreme drought of 1934 affected all 18 stations of the Division of Dry Land Agriculture throughout the Great Plains from Montana and North Dakota to Texas, resulting in almost complete failure of all crops irrespective of cultural method. The few exceptions were mainly due to timely showers. Precipitation during the year (January to December) ranged from 6.13 inches at Tucumcari, N. Mex., to 20.25 inches at Woodward, Okla., and at 11 of the 18 stations it was less than 10 inches. The precipitation during the growing season ranged from 3.84 inches at Huntley, Mont., to 13.58 inches at Woodward, Okla., and at 13 stations it was less than 8 inches.

Reaction of crops to differences in cultural methods was sometimes striking during the extremely dry and hot season of 1934. The best grain sorghum at Hays, Kans., was on plots cropped continuously to kafir for a number of years with the stalks worked into the ground. Corn reacted similarly; the only corn to come through the drought and then form silks and tassels after late rains was that on plots cropped continuously to corn with the stalks worked in.

### CONTROL OF WIND EROSION

Experience on the dry-land field stations during the extreme drought that in some sections has extended in 1935 into the third season emphasized the fact that agricultural soils may be protected by cultivation against serious loss by blowing. In a solidly cultivated area, however, general community action is necessary: a field allowed to remain in a blown condition is a plague spot from which destruction spreads to other fields. Individual protection then can be had only by windbreaks of trees, hedges, or snow fences that trap the drifting soil. Because so many fail to provide protection by cultivation or otherwise, the highest degree of safety can be attained only by organizing the farming systems and cropping methods so that the fields liable to blowing are broken up into much smaller units than now obtain where wheat has been grown almost exclusively.

## FORAGE CROPS AND DISEASES

A. J. PIETERS, *in charge*

During the year the Division of Forage Crops and Diseases was in close touch and cooperated extensively with the crop replacement section of the Agricultural Adjustment Administration, with the Soil Erosion Service, and with such other emergency organizations as required information on forage crops. Meanwhile the research along various lines has progressed.

### ALFALFA

Additional selfed lines of alfalfa highly resistant to bacterial wilt were developed. These were tested also for cold resistance, and only those showing resistance to cold and to bacterial wilt and which were at the same time vigorous



and good seed producers were retained for propagation. Approximately 40 of these strains trace back through individual plant pedigrees to old fields in Nebraska or to the Westover collection from Turkistan, Persia, and India. These strains now apparently are sufficiently homozygous to insure resistance in succeeding generations, provided there is no contamination, and their propagation is the next step in the alfalfa-improvement program.

#### RED CLOVER

Progress has been made in developing a strain of red clover resistant to mildew. Studies in the production of seed of a variety resistant to the southern form of anthracnose have shown that this strain can be grown with slight deterioration in the Pacific Northwest for four generations, after which new seed should be secured from pedigreed stocks in Tennessee.

#### SWEETCLOVER

In cooperation with the Wisconsin Agricultural Experiment Station, an important research problem was undertaken during the year, looking toward the breeding of a sweetclover that shall be free from the toxic principle so often causing serious losses to cattle fed on spoiled sweetclover hay.

An adapted variety of sweetclover has been established for the Pacific Northwest where the stem-rot disease is destructive, and 50,000 pounds of seed was produced in 1934 in Oregon.

Methods of establishing stands in the semiarid region have been worked out for the use of sweetclover for erosion control and for forage.

Experiments carried on for some time at Hays, Kans., have demonstrated the value of sweetclover for the western Great Plains. The drought of 1934 brought out strikingly the value of this plant. While new seedlings failed, the established plants continued to flourish and furnish pasturage when all other vegetation was dried up.

#### SOYBEANS

The soybean continues to be of increasing interest in agriculture and industry. Extensive tests throughout the United States have indicated clearly that the large seed-producing areas have resulted primarily from the development of varieties especially suited to these particular regions. Increased acreage and production have been closely correlated with the Bureau's introduction and development of new varieties. Selection from promising Manchurian introductions has made the Corn Belt States the leading seed-producing region. Experiments with varieties adapted to various parts of the United States were continued, with special emphasis on the adaptedness of different varieties to use in the industrial field.

#### ACID-TOLERANT LEGUMES

The experiments with acid-tolerant legumes have been pushed, especially with species of *Lespedeza* and *Crotalaria*, the former for the heavier and the latter for the sandy lands of the South.

The Bureau introduced Kobe and Korean lespedezas and, more recently, the perennial *Lespedeza sericea*, all of which are proving valuable in erosion control and in the saving of millions of acres of land in the South. Breeding is under way with lespedezas as well as with crotalarias, and already distinct improvement has been made. Earlier and later varieties of Korean lespedeza have been developed and are now being tested in the field and propagated.

An early variety of *Crotalaria spectabilis*, first selected in 1929, has shown such superiority for the latitude of the Carolinas that it is now in commercial production. In cooperation with the Florida Agricultural Experiment Station it has been shown that *Crotalaria intermedia* is definitely of forage value, and commercial plantings for seed production will be made.

#### PROTEIN CONTENT OF SOUTHERN PASTURE GRASSES

Cooperative pasture investigations have shown that the average protein content of southern pasture grasses is lower than that of northern grasses. Great difficulty is experienced in maintaining legumes in southern pastures except on certain favorable soil types. Under these conditions applications of nitrogen fertilizer in reasonable amounts are justifiable because they increase both the yield and the protein content of the herbage.



## BUFFALO GRASS

Study of methods of reestablishing buffalo grass on cultivated land was begun in cooperation with the Kansas Agricultural Experiment Station at the Fort Hays Branch Station in 1929. The results of this work (published as Circular 328) indicate that under normal rainfall conditions pieces of buffalo grass sod 4 inches square set 3 feet apart in cultivated soil will spread sufficiently in 3 years to cover all the intervening space. The importance of this finding lies in the fact that buffalo grass seed is not available commercially and is very difficult and expensive to harvest; also that it requires from 20 to 50 years for buffalo grass to become reestablished naturally on abandoned farm land. With ordinary farm machinery equipped with special devices, which can be made by any village blacksmith, a three-man crew can scatter and set these sods over a considerable acreage rapidly and at small expense other than for labor.

## FOREST PATHOLOGY

HAVEN METCALF, in charge

## CHESTNUT BLIGHT ON THE PACIFIC COAST

As this country imports 20 to 25 million pounds of chestnuts annually from Europe and Asia in normal times, it would seem that the chestnut-orchard industry has good prospects on the Pacific coast if the two principal pests in the East, the chestnut blight and the chestnut weevil, can be prevented from becoming established there. Chestnut blight infections have been found in several localities on the coast in the past and the affected trees have been destroyed. In the fall of 1934 the disease was found for the first time in California near Stockton, where it was very virulent on European chestnuts, and there was every indication that this species cannot be successfully grown there unless the blight is kept out. All the affected trees found were eradicated.

## CORYNEUM CANCKER OF CYPRESS

The coryneum canker of cypress, first discovered in California in 1927, and induced by a species of fungus not previously known, is estimated to have caused the death of between 15,000 and 20,000 planted trees, mostly Monterey cypress (*Cupressus macrocarpa*). Many of the columnar form of Italian cypress have also been killed. Principal losses have occurred in the section adjacent to San Francisco Bay and in the orchard districts of southern California. Serious damage occurs only where the disease has been allowed to intensify locally for several years. The disease is not yet present in the famous native groves of Monterey cypress on the California coast near Carmel, though investigations have indicated that the native trees are susceptible to the disease. By proper protective measures these areas and others where the disease has not yet gained a foothold may be saved.

## DUTCH ELM DISEASE

The greatly expanded control campaign against the Dutch elm disease in the vicinity of New York City by the Bureau of Entomology and Plant Quarantine made desirable the moving of the principal research laboratory from Wooster, Ohio, to Morristown, N. J., in the infected area. During the year it was determined that the *Graphium* stage of the causal organism may be distributed under experimental conditions by the wind, that the fungus will grow saprophytically on more than 20 kinds of wood, and that the disease occurred in 4 trees at Indianapolis, Ind., and in 1 at Norfolk, Va. Plus and minus strains of the fungus were isolated from material collected at various places in the infected area, and the sexual stage has been produced a number of times in the laboratory from strains collected in the United States. Of 15,334 suspected trees cultured in the diagnosis laboratory, 6,459, or about 42 percent, proved to have the Dutch elm disease.

## SEEDLING DISEASES OF BLACK LOCUST

Since the great expansion in black locust production incident to the soil conservation and other programs, occasional heavy losses from various parasitic and nonparasitic agencies have been reported by nurserymen and others. In one nursery serious membracid injury was discovered. In two nurseries

during the past two seasons large numbers of black locust seedlings have been killed by a wilt. *Phytophthora parasitica* has been isolated from the seedlings and has been proved to be the cause of the disease. Symptoms of the phytophthora wilt are distinct from a rhizoctonia seedling disease of the same host. The phytophthora wilt has been found to be effectively controlled in the greenhouse and in the field by spraying with bordeaux mixture or by increasing the soil acidity to about pH 4.6 with aluminum sulphate.

#### DECAY HAZARD IN SPROUT OAKS

As a result of extensive studies in the Allegheny and Appalachian areas the decay hazard in thinned and unthinned sprout oak stands has been found to be surprisingly high. The decay occurs as butt rot, which enters the standing sprout principally from the old stump but to some extent from cut stubs following thinning practices. Black oak has been found most affected, chestnut oak least, and red, scarlet, and white oaks intermediate in susceptibility. *Stereum gausapatum*, a previously little known heart-rotting fungus, has been by far the most important causal organism. Decay hazard appeared greatest where sprouts originated from large stumps or high on the stump and where open wounds occurred at the base. In thinning sprout stands the greatest decay danger was found where there was a high union between sprouts and where the stems removed were over 3 or 4 inches in diameter.

There are indications that seedlings, seedling sprouts, and sprouts arising from low-cut and small stumps should be favored in forest-improvement practices. Thinning sprout groups by cutting one or more stems in a group seems to increase the decay hazard, but less than previously supposed. If cull is to be avoided in stands grown to saw-log size, the logical procedure would seem to be to depend on stands of seedling or seedling sprout origin. Repeated coppicing should be avoided except where timber crops based on short rotation are to be grown. The results affect directly the forest stand improvement work of Civilian Conservation Corps camps and other forest management practices and have been of considerable value also in connection with forest inventories now being made extensively throughout the forested regions.

### FRUIT AND VEGETABLE CROPS AND DISEASES

E. C. AUCHTER, *in charge*

Investigations in the breeding, culture, and diseases of fruits, nuts, vegetables, and ornamental plants and their handling, storage, and utilization were continued in numerous projects.

#### FRUIT PRODUCTION

##### CONTROLLING SETTING OF APPLES

In many apple orchards the trees bear heavily one year and give a very light crop the following year. In general this alternation occurs in the same year throughout the apple-growing areas in large sections of the country. By destroying the crop of a considerable portion of the trees in a normal full-crop year, and thus causing those trees to bear abundantly the next year, an equalization of the crop could be brought about which might result in better returns to the grower. The real problem is to find a spray that will destroy the blossoms or prevent them from setting fruit, but without injury otherwise to the tree or foliage. Experiments have been carried on during the last two springs with this objective in view. A 3-percent tar-oil distillate applied at the late cluster-bud stage has given considerable promise. This spray killed the buds where applied thoroughly, and no serious injury resulted to the fruit spurs, although the foliage was somewhat injured.

##### RESPONSE OF SWEET CHERRY TREES TO PRUNING

In the Sacramento Valley in California heavy loss is sustained by cherry growers because of the large quantity of double fruits that develop. In an attempt to diminish the development of double fruits, rather heavy cutting back of the branches of the trees was tried, with considerable success. On a 10-year-old tree of the Bing variety, the branches of which were all headed



back several feet just after the harvest in 1932, there developed in the crop of 1934 only 11 percent of double fruits. In comparable trees not headed back the double fruits comprised 47 percent of the crop.

Incidentally, trees that were pruned in this experiment responded well, indicating that sweet cherry trees withstand pruning as well as other fruits, contrary to the general belief of growers. The pruning resulted in an increase in the size of the fruit as well as in reducing the percentage of doubles. The vegetative response to pruning, however, differs somewhat among different varieties.

#### RESULTS OF THINNING DATES

Previous experiments in the commercial application of metaxenia have shown the need for data on the effect of thinning on the size, time of ripening, and grade of dates. In large-scale bunch-thinning experiments with Deglet Noor dates in 1934 the unthinned dates ripened 1 to 7 weeks later than those under any of the other treatments, the difference increasing as the season progressed. The unthinned bunches were conspicuous early in the season for the large proportion of prematurely shriveled dates, almost absent from any of the thinned bunches. Size was increased in proportion to severity of thinning, but grades were not significantly bettered except as to size. None of the unthinned dates attained the minimum size required by present grade standards. "Blacknose" was almost entirely absent from the unthinned dates and affected the thinned dates in direct proportion to the severity of thinning.

A subsequent adverse reaction from the heavy crop carried by the unthinned palms was observed on March 29, when it was found that every palm on which the fruit had been thinned in 1934 was producing a normal crop of flowers in 1935, with three-fourths or more of the usual number already in sight, whereas more than two-thirds of the palms on which the fruit was unthinned had no flowers in sight and there were only a few on any of the others.

#### STRAWBERRY INVESTIGATIONS

Since the Blakemore strawberry variety has proved unsatisfactory in some sections, a study was undertaken to determine some of its cultural requirements, particularly with respect to the spacing of the plants. As an experiment, this variety was grown in 30-inch and 12-inch wide matted rows, in 24-inch wide spaced rows with all runner plants 6 and 9 inches apart, and in double hill rows with the plants 12 inches apart each way. The 30-inch matted row had over 35 times as many plants per foot of row as the double hill row. The latter, however, produced 2.4 times as much salable fruit as did the matted row, and the 9-inch spaced row 3.2 times as much as the matted row. The wider spacing of the plants was also found to be one of the best methods of controlling decay of the fruit. After shipping to a northern point there was a 5-percent decay in the fruit produced by the double hill row plants, as compared with 26 percent in the fruit from the matted row.

An explanation of the response of the so-called "everbearing strawberries" to their environment exists in the fact that such varieties have been found to be "long-day" plants and form fruit buds under the long days of summer in the Northern States. Ordinary varieties are "short-day" plants, rarely forming fruit buds except in the fall, when the days become short and the temperature low. All varieties are considered to have characteristic temperature-day length responses which determine their regional adaptation.

#### CONTROL OF CRANBERRY DISEASES

The fungicidal spray program for the better control of cranberry fruit rots was extended and better spraying was encouraged through overcoming objections and obstacles to the use of bordeaux mixture. There was a further demonstration of the disastrous effects on the rotting of the fruit of repeated June reflows of the cranberry fields, such reflows being made, particularly in New Jersey, for the purpose of controlling the leaf hopper, which is the vector in spreading the false-blossom disease. It was also shown that if a field is to be reflowed in June as a means of insect vector control, spraying the plants with bordeaux mixture the day before the reflow lessens the bad effect of the flooding, though it does not entirely counteract it. Successive annual reflows have been found to result in cumulative fungus infestation. The development of sprays and dusts for the control of the insect vector makes practicable the omission of reflowing.



## NUT PRODUCTION

## FACTORS AFFECTING YIELD OF PECANS

Experiments continued over several seasons indicate that early defoliation of pecan trees (which occurs as early as May) results in a poor set of nuts, and later defoliation (July to October) results in small or poorly filled nuts or both. Defoliation from injury caused by insects or fungus diseases, when the trees are maturing a crop of nuts, has been found to result in total or partial failure of pistillate blossoms to develop the following year. Even when healthy foliage is retained throughout the season, approximately 6 large leaves are required properly to develop and fill a single nut, and 8 or more leaves are required to develop it fully and to provide for the storage of sufficient food reserves in the tree for the development of sufficient pistillate bloom the following year to insure a commercial crop.

It has been found that the general effect of pruning is to dwarf the tree and to reduce somewhat the total production of nuts, with little or no increase in size or degree of filling. Because of the better control of insects and diseases and the easier harvesting of the nuts, a limited amount of pruning may be justified, but in general it should be light and consist in thinning out the tops of the trees.

## MOISTURE REQUIREMENT OF PERSIAN WALNUTS

Extensive soil-moisture determinations made in the Northwest in relation to the behavior of Persian (English) walnut trees, particularly with respect to the development of the nuts, have made it clear that the trees in nonirrigated orchards in many locations suffer at one or more periods during the growing season for lack of sufficient moisture to enable the nuts to develop properly. Insufficient moisture results in the shriveling of the kernels; in some cases this is so great that the nuts cannot be graded.

## HANDLING, TRANSPORTATION, AND STORAGE OF FRUITS AND VEGETABLES

## TRANSPORTATION OF ORANGES

In the orange precooling and transportation investigations it was found that noniced shipments precooled at railroad refrigerating plants for 8 hours could be forwarded without icing and with the ventilators closed for the first 24 to 48 hours, while traversing the hot desert region, after which ordinary ventilation could be used for the remainder of the time in transit. This type of service had never before been provided, and the railroads had no rate applying to it, formerly having charged \$25 a car for precooling at their plants, in connection with which, however, it was necessary to forward the shipment under ice thereafter. In view of the demonstration of the effectiveness and utility of precooling without icing during the cool periods of fall and spring, a rate of \$10 a car was published for the new service.

In the movement of oranges by boat from California to the Atlantic seaboard, considerable trouble has been encountered from the development of physiological disorders in the fruit during transit, particularly on ships equipped with certain methods of refrigeration and air distribution. A test trip in October 1934, provided information which made it possible to correct the principal troubles experienced with that kind of refrigeration and may be generally applied to the storage and refrigeration of citrus fruits in both intercoastal and export trade.

## USE OF ANTISEPTICS ON CITRUS FRUITS

Investigations in the use of antiseptics on citrus fruit showed that sodium metaborate is practically as effective as borax and on account of its higher solubility offers some advantages, since the solution does not need to be heated at any time during the shipping season. In addition to proving to be a satisfactory antiseptic, sodium metaborate was shown to have satisfactory detergent properties.

## STORAGE TEMPERATURES FOR GRAPEFRUIT

The most satisfactory method thus far developed for storing grapefruit is the use of a temperature of 32° F. for a period of about 1 month, to be followed by storage at 50° to 55°. This combines the advantage of the low-temperature

storage in preserving the quality of the fruit and extending its storage life with that of freedom from pitting which is accomplished by holding at the higher temperature. If the fruit has been properly treated with borax or sodium metaborate for the control of stem-end rot, this method should permit the satisfactory storage of grapefruit for a longer period than has hitherto been commercially feasible.

#### STORAGE OF PEARS IN THE PACIFIC NORTHWEST

In storage experiments with winter pears in the Pacific Northwest it was found that loss of ripening capacity is not due, as formerly believed, to the cold temperature alone. Bosc pears could be maintained in excellent condition with full capacity to ripen normally for a period of 6 weeks longer at 30° F. than at 32°. The commercial application of these findings is quite obvious in view of the fact that a large portion of the Bosc pear crop is held at a temperature nearer 33° or 34° than 32°, especially at the beginning of the storage period. It appears that a temperature of 29° to 30° could be profitably used for these pears, as well as for Comice and Flemish Beauty, if means of accurately controlling the temperature at this minimum point could be provided.

Cooperative studies on the effect of cultural methods on the storage and ripening quality of Anjou pears, conducted at Medford, Oreg., demonstrated that the frequency and time of irrigation of the trees have a marked influence on the subsequent behavior and quality of the fruits in storage. In general, the pears from the more heavily irrigated trees had a better finish, size, and texture and retained desirable qualities for a longer time in storage. However, the pears from the heavily irrigated trees were not as sweet or sprightly in flavor as those from the drier plots. On the whole, the best quality fruit has been obtained from the trees that were relatively dry during the latter part of the season.

#### PACKING APPLES

The study on the packing of apples in barrels to prevent excessive loss from decay and slackness during export to foreign countries has been completed. In general it has been found that barrels should be filled to a height of three-quarters of an inch above the staves and shaken when one-third and two-thirds full and, of course, racked with the plug in place after the barrel has been filled.

#### REMOVAL OF SPRAY RESIDUE FROM CURRANTS

The use of  $\frac{1}{2}$  to  $1\frac{1}{2}$  percent hydrochloric acid was found effective in removing the excessive spray residues from currants. This fruit was found to be quite resistant to acid injury but very susceptible to decay after any washing treatment unless kept under low temperature or conditions that permit rapid drying.

#### MARKET TROUBLES IN HANDLING SHELLLED LIMA BEANS

Within the last year or two there has been a considerable development in the marketing of shelled lima beans, but with more or less trouble from the spotting and stickiness of the beans, caused by various bacteria and fungi. Investigations show that the trouble can be controlled by holding the beans at a temperature of 40° F. or lower, by holding them in carbon dioxide, or by washing them in 30-percent alcohol. The carbon dioxide treatment seems to be the most practical from a commercial standpoint. Other antiseptic washes were tested, but either they did not prove effective or the necessity for subsequent rinsing to remove undesirable residues rendered them less practical.

#### VEGETABLE PRODUCTION AND DISEASES

##### TOMATOES

Physiological studies have shown that one of the primary causes of puffiness in tomatoes is unfavorable water conditions, while other factors that may affect ovule fertilization also play an important part. Maintenance of a uniform and adequate water supply and avoidance of low temperatures prevent the trouble in large measure.



## LETTUCE

The factors responsible for the development of red pigment in lettuce and the method of inheritance of different types of red color have been determined. This is of much importance to the practical seedsman and particularly to the plant breeder and the theoretical worker.

Two new varieties of lettuce resistant to brown blight, Imperial No. 152 and Imperial No. 165, which have been developed for winter culture in the Imperial Valley and similar sections, have come up to the best expectations. Nearly all of the 30,000 acres of the winter crop in the Imperial Valley and a large part of some 25,000 acres grown in Arizona are of these varieties.

## ONIONS

In connection with cooperative work on varietal standardization of onions and in cooperative studies with the Division of Tobacco and Plant Nutrition, explanations have been found for the marked difference in behavior of different onion varieties when grown in different parts of the United States. Varieties commonly grown in the North require a long day and cannot be made to develop satisfactory crops in the southernmost part of the United States, particularly in winter. Certain varieties adapted to the Gulf coast and farther south are totally unsuited to the North because they mature at the approach of longer days and will not develop satisfactory size no matter how favorable other conditions may be.

## POTATOES

The new potato varieties developed by breeding and introduced to the trade by the Bureau are making excellent headway. The Katahdin and the Chip-pewa, white-fleshed varieties, continue to show resistance to mild mosaic. Approximately 100,000 bushels of the Katahdin and 1,500 bushels of the Chip-pewa were grown in the various cooperating States in 1934. The latter variety seems widely adapted, as shown by reports from a number of experiment stations.

Additional progress has been made in breeding potatoes for resistance to both scab and blight. A selection from the earlier breeding work has consistently shown high resistance to scab. A considerable number of seedlings resulting from a cross of this selection and a white-skinned seedling appeared to be resistant to scab in 1934. Several new introductions of alleged scab-resistant varieties have been imported from Europe.

In breeding for blight resistance 2 or 3 resistant named varieties already in the trade were used as checks in determining or comparing blight resistance of seedlings. A number of the selections were more highly resistant than the older varieties, while a much larger number indicated about the same degree of resistance. From the selections that have proved to be the more highly resistant to late blight it is believed that valuable improvements can be selected.

## TESTS OF MATURITY OF ROSE STOCKS

The experience of rose growers in recent years in the use of manetti stocks in propagating rose plants for forcing was costly and unsatisfactory in many cases, because of the failure of the plants to grow or to develop properly. Investigations by Bureau specialists showed that the principal difficulty was due to the stocks being dug prematurely and before the wood was well ripened. The principal growers of manetti stocks in the Northwest have adopted the Bureau's suggestions and are now delaying the digging of the stocks until no doubt remains as to their maturity. The starch test for maturity, developed as a part of the investigations, is being used.

## COPPER PHOSPHATE, A NEW FUNGICIDE

Experiments in the use of the new copper phosphate fungicide and the carrier, lime-bentonite, developed in the laboratories of the Division of Fruit and Vegetable Crops and Diseases, in spraying apples, pears, peaches, and grapes, were conducted in the vicinity of Washington, D. C., in Missouri, Arkansas, and elsewhere, during the growing season of 1934. In the case of peaches a small amount of leaf injury developed from the earliest applications, but later



applications caused no injury. In the case of apples to which lime-sulphur and bordeaux mixture were applied according to the normal spray schedule, severe injury to foliage resulted, while the new fungicide caused no injury. During the severe drought period of midsummer it was observed that apple trees treated with copper phosphate retained their leaves, while trees otherwise sprayed lost a large proportion of the foliage.

The new fungicide was effective in controlling the leaf spot disease of Kieffer pear and was largely responsible for a decided increase in the fruit crop. Applied to Concord grapevines, it proved to be less injurious to the foliage than bordeaux mixture. Vines sprayed with it appeared to resist drought better than vines otherwise treated.

Present indications are that this new spray, composed of copper phosphate, lime, and bentonite, with the use of an effective sticker, may largely if not entirely replace some of the older fungicides in the control of many of the apple, peach, pear, and grape diseases. It may not be fully effective, for instance, in the control of severe infections of apple scab in highly susceptible varieties.

## GENETICS AND BIOPHYSICS

G. N. COLLINS, *in charge*

The study of inheritance in plants and of the mechanism by which characters are transmitted is a continuing project. A large part of this work is done with maize and its relatives. The choice of this plant as a subject for study was made because of the uncertainty as to its origin and because of its unusual suitability for genetic investigations.

### NATURE OF HYBRID VIGOR

An experiment was conducted to test the theory advanced by Ashby that the growth rate of first-generation hybrids is no greater than that of the more rapidly growing parent, the greater size of the hybrid being due to initial differences in the size of the embryos. The results only partially confirm Ashby's findings. There was a significantly higher growth rate of the hybrid plants for the first 2 weeks after germination, but after that time no difference in rate could be detected.

Preliminary experiments indicate that germ weight or increase in germ weight over that of the parent may be of value in selecting desirable combinations of selfed strains. Two especially high yielding combinations among seven tested had much heavier germs than low-yielding combinations. A simple and rapid method of removing the germs has been devised.

## MYCOLOGY AND DISEASE SURVEY

H. A. EDSON, *in charge*

### PLANT-DISEASE SURVEY

Information regarding the incidence of plant diseases throughout the United States has been collected through the cooperation of the plant pathologists of the country and distributed to collaborators and other interested persons through the pages of the mimeographed Plant Disease Reporter. Volume 18, concluded during the year, contained 18 numbers and a total of 222 pages, exclusive of supplements. Crop-loss estimates covering the 3 years 1931, 1932, and 1933 and the usual Annual Summary of Plant Disease Occurrences for the preceding season have been prepared and distributed as supplements to the Reporter.

### MYCOLOGY

Approximately 16,000 specimens were added to the mycological collections of the Bureau, including standard exsiccati sets as issued and much material representative of the plant-disease work of the Bureau. An inventory revealed that the collections, including associated collections, contained 366,774 fungus specimens, over 13,000 negatives, 25,000 permanent microscopic mounts, 10,000 reprints, and extensive supporting indexes.

Routine identifications of fungi totaled several thousand, having been made for State and Federal workers and amateur mycologists in this country and for many foreign collectors. Special studies have been made of the fungi of

Alaska and of the District of Columbia area and of the bamboo fungi of China. Technical investigations under way relate to the several *Sphaelomonas* causing diseases of economic plants, the fungi attacking corn, and the entomogenous fungi attacking the corn earworm and other economic insects.

## NEMATOLOGY

G. STEINER, *in charge*

### PLANT-PARASITIC NEMATODES

In order to save valuable breeding and nursery stock afflicted with nematode diseases, or to prevent the introduction of such diseases on imported plant material, the only satisfactory method known at present is a hot-water (in some instances a vapor-heat) treatment. The principle involved is the submerging of the diseased plants or parts for a sufficient length of time in water of a temperature lethal to the nematode but not to the plant. The temperature required varies for different species of nematodes and their stages of development. At present the hot-water treatment is most widely used to rid narcissus bulbs of the bulb or stem nematode. In this case treatments rarely result in complete annihilation of the nematode; a few specimens always seem to escape. Through extensive investigations, in cooperation with the Division of Truck Crop and Garden Insects of the Bureau of Entomology and Plant Quarantine, the cause of failure was found to be the presence in these bulbs of quiescent (and therefore more resistant) specimens of the bulb or stem nematode. As the bulbs become dormant and drier during storage, the number of nematodes reaching the quiescent or dormant stage becomes greater. Such dormant nematodes have survived temperatures of 130° F. and more, whereas normally active specimens succumb at 111°. An early treatment of the bulbs is therefore much more efficient for nematode control. Dormant bulb or stem nematodes are revived most satisfactorily by submersion in water of between 70° and 80°, lower or higher temperatures causing them to continue in the quiescent state. Accordingly, presoaking, if properly carried out, helps to increase the efficiency of the subsequent treatment.

Other investigations concerned the control of the root-knot nematode in tuberose tubers by hot-water as well as vapor-heat treatments. Here a treatment with hot water at 118° F. for half an hour proved entirely satisfactory, although the dormant tuber will withstand for half an hour temperatures as high as 124°, the growth of the plant seeming to be stimulated thereby. Co-operative work with the aforementioned division showed that these treatments are also effective in the control of mites and therefore serve a double purpose.

The effect of hot water on the strawberry nematode showed a difference in the resistance of individuals from strawberry plants, from chrysanthemums, and from begonias, the lethal points with half-hour treatment being 118°, 112°, and 108° F., respectively.

### NEMATODES PARASITIZING INSECTS

A very efficient and promising nematode parasite was recently discovered in corn earworm larvae, attacking them in the soil and killing them within a few days. This nematode is closely related to a form attacking the Japanese beetle larva and at present studied by some outside agencies. The new species is more promising because, in contrast to the Japanese beetle parasite, which seems to be highly specialized on its host, it attacks a variety of insects, such as the larva of the house fly, army cutworm, wireworms, and others, including the Japanese beetle larva. In cooperation with the Division of Cereal and Forage Insects of the Bureau of Entomology and Plant Quarantine, methods of artificial culture and propagation of this parasite are being studied and further transfer experiments carried on. This nematode multiplies very rapidly, forming a compact mass of thousands of specimens inside the dead insect larva. The latter persists in what may be termed a "mummified" condition even for months (e. g., over winter) until left by the nematodes. These released parasites are then in a resistant "ensheathed" stage. It is thought that this nematode may be of value in the control of the "soil phase" of various insect pests.



## PLANT EXPLORATION AND INTRODUCTION

B. Y. MORRISON, *in charge*

It is the function of this Division to procure from foreign and domestic sources by exploration, purchase, and exchange new and valuable economic and ornamental plants that give promise of usefulness in the agriculture and horticulture of the United States. During the year 5,925 such introductions were inventoried. Material released and distributed to research workers and collaborators for testing amounted to 112,903 items, in the form of plants, seeds, bud sticks, cuttings, roots, and tubers. Over 2,000 collections of seeds and roots were gathered by the Bureau's explorers from the Union of Soviet Socialist Republics, Turkey, Turkistan, and China for testing in soil-erosion control.

### SOIL-EROSION NURSERIES

Before the transfer of the soil-erosion nurseries from this Bureau to the Soil Conservation Service in April 1935, more than 8,000,000 plants had been delivered to the Soil Erosion Service in the autumn of 1934 and arrangements had been completed for the delivery during the calendar year 1935 of more than 82,700,000 plants.

Seeds of over 200 species of native grasses were collected by botanical crews of the soil-erosion nurseries during the year. These collections, made for the Soil Conservation Service, represent in some cases the first collections from the areas visited, in quantities sufficient to establish the species in commercial cultivation.

Propagation material of shipmast locust had been brought into quantity by collection. This form of black locust produces better, straighter timbers that appear more resistant to insect attack than the type form of the species.

### AMERICAN GRASSES

The native American grasses constitute a most valuable asset to agriculture and animal husbandry, and especially to erosion control and soil conservation. For many years the grass specialists of the Department have been collecting and studying the many species found in the United States and comparing them with species found in other parts of the world. The results were brought together during the year into a comprehensive publication entitled "Manual of the Grasses of the United States." This is a cloth-bound volume of 1,040 pages with 1,696 illustrations. It will constitute the standard reference work on this important subject and will be an invaluable aid to those interested in grasses either from a botanical or an agricultural standpoint. The only copies available are for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.

### NATIVE RUBBER-PRODUCING PLANTS

For many years the Department has been collecting and testing plants that might prove to be of some value in rubber production. Seventeen thousand herbarium samples of native rubber-bearing plants, collected by the late Thomas A. Edison, were brought to Washington and the botanical identifications checked. It is hoped that the results of this survey may be assembled and made available to the public. This represents part of the material transferred to the Bureau of Plant Industry by the Edison Botanic Research Corporation. Strains of goldenrod selected for rubber content by H. G. Ukkelberg, working with the Edison Botanic Research Corporation at Fort Myers, Fla., and all accumulated data thereon also were given to the Bureau. The selected strains were transferred to Savannah, Ga., where they will be grown along with material selected by the Bureau and previously grown near Charleston, S. C. Individual plants of the Edison strains have attained a rubber content of as much as 13 percent. The Bureau strains, on the other hand, have attained only some 8.6 percent, but because of heavier plant yields the yield of rubber per unit of area exceeds that of the Edison strains. It remains to determine the progress that can be made by hybridizing these strains and making selections.

In cooperation with the Bureau of Standards, vulcanization experiments were carried on with crude rubber obtained from goldenrod. The results were encouraging, but better methods of extracting the rubber are needed.



Over 8,000 analyses were made of goldenrod samples from Fort Myers, Fla.; Savannah, Ga.; Charleston, S. C.; and Harrogate, Tex. A distinct difference between species was found; those yielding the highest in the southern locations yielded poorly farther north.

#### PLANTS USED AS INSECTICIDES

The Division, through the courtesy of E. P. Killip, of the United States National Museum, and A. C. Smith, of the New York Botanical Gardens, has been able to issue in mimeograph form a 27-page systematic list of 140 South American plants known to be used as fish poison, with a very full list of native names under each species and an alphabetical list of all native names for cross reference.

A total of 300 lots of seeds, cuttings, and roots of plants used as insecticides in South America were introduced by the Bureau's two collectors on that continent during the year. This subject is of special interest at the present time in view of the necessity of finding insecticides to replace arsenic and lead in certain cases, and several bureaus are cooperating in the investigations. From these introductions some 5,200 plants have been propagated at plant introduction gardens and are now being tested in Florida, California, Texas, and Puerto Rico.

#### QUETTA NECTARINE

The commercial development of the Quetta nectarine, introduced by the Bureau some years ago, has reached the stage where there are over 400 acres planted in California. During the last 4 or 5 years this nectarine has been shipped in carload lots to eastern markets and brought excellent prices during a period when returns from other fruits have been lower than usual. In 1934 several companies experimented with the canning of this clingstone nectarine, apparently with much success, for their buyers have been offering almost twice as much per ton for Quetta nectarines as for cling peaches.

#### NATIONAL ARBORETUM

The purchases of land for the National Arboretum now amount to 386 acres, and to this the President has authority to add land from the 640 acres now in process of reclamation from the upper Anacostia River marshes.

A 1-sheet topographic map of the Arboretum has been made on the scale of 200 feet to the inch with 5-foot contours and a 37-sheet map on the scale of 40 feet to the inch with 1-foot contours.

Through labor from a Civilian Conservation Corps camp located at Fort Du Pont and another located on the Arboretum itself, and with emergency funds, the dead and dying trees have been removed from the Arboretum area and the old farm land that had grown up to weeds has been cleared, plowed, and planted to soil-improving crops.

The small temporary nursery established a few years ago has shown the excellent results that can be expected from future permanent plantings at the Arboretum.

As soon as provision can be made for fencing and for the construction of roads, paths, greenhouses, and other working facilities, the constructive work of the Arboretum, including the breeding of new and improved varieties of trees, can be begun.

#### SEED INVESTIGATIONS

EDGAR BROWN, *in charge*

##### LIGHT SENSITIVITY IN SEEDS

The investigation of light sensitivity in seeds was continued, in cooperation with the Smithsonian Institution. The principal results of the year were—

(1) A strong inhibitory band in the spectrum in the region of 7,600-Å, at the extreme limit of the visible red, was discovered. Under both solar and Mazda lamp radiation there is a large amount of energy in this region. The presence of this band, transmitted by many light filters, has probably been a source of confusion in the interpretation of results obtained in qualitative light investigations.

(2) The inhibitory activity of the violet-blue-green region of the visible spectrum was found to have two critical wave lengths, a major one in the 4,400-Å

region and a subordinate one in the 4.800-A region. Within the range of experimental error these two critical wave lengths are the same as those found by other investigators to characterize phototropism. It thus appears that the action of light on seed germination may also relate to the more general principles involved in the reactions of organisms to light.

#### ENFORCEMENT OF THE FEDERAL SEED ACT

All importations of seeds subject to the Federal Seed Act are sampled by the Customs Service, the samples are tested for quality by this Division, and the collectors of customs are notified of the results. During the fiscal year 932 lots (26,272,760 pounds) were permitted entry and 69 lots (5,258,200 pounds), mostly Manchurian millet, were rejected, although the major part of this rejected seed was later recleaned and permitted entry. The total number of permitted entries includes these lots of recleaned seed. Owing chiefly to the present import duty, there was only a very small importation of alfalfa and practically none of red clover and alsike clover, with the exception of American goods returned. Because of the unusual shortage of certain seeds of which the United States normally produces an excess, there were importations of important amounts of timothy, oats, and foxtail millet, which are subject to the Federal Seed Act, and Sudan grass, which is not. This is the first year that imports of timothy have been of importance.

In the enforcement of section 6 of the Federal Seed Act, prohibiting the interstate shipment of misbranded seeds, 20 criminal prosecutions and 34 seizure cases were reported by the Department of Justice as terminated, and 23 criminal cases and 8 seizure cases were pending at the close of the fiscal year. Investigations were in progress relative to approximately 110 cases reported by various States as violations of the act.

As a result of the enforcement of the interstate section of the act, seed dealers are taking more interest in varietal identity and seed testing. Misbranding as to variety, particularly of rye, soybeans, sorghum, and oats, has been given increased attention. Owing to the similarity in appearance of seeds of different varieties, it has become necessary for the Bureau, wherever possible, to develop means of making varietal identifications in the seedling stage.

Information has been given to the press from time to time and publications have been issued in an attempt to discourage the sale of misbranded seeds.

#### SOIL FERTILITY INVESTIGATIONS

OSWALD SCHREINER, *in charge*

##### ACID-FORMING FERTILIZERS

Field studies on a number of leading soil types with different crops have indicated the importance of correcting potential fertilizer acidity, otherwise serious leaching of the basic soil compounds will occur and the fertility of the soil will be impaired. This may be accomplished by addition of dolomitic limestone to the fertilizer.

On four large soil types used generally for cotton production, acid-forming fertilizers gave as good cotton yields as neutralized fertilizers, and on three large cotton soil types the yields from neutralized fertilizers were greater. Acid fertilizers made from chemicals of high concentration yielded larger returns when neutralized with basic materials, although on some soils the addition of calcium sulphate, a nonneutralizing salt, gave better results than neutralizing agents such as limestone, indicating that the beneficial results on these soils may be due to calcium as a plant food rather than to its effect in neutralizing acidity.

On acid soils used for strawberry growing in the southeastern coastal section, acid-forming fertilizers increased the acidity of the soil and were unfavorable to strawberry plant viability and fruit production, whereas base-forming fertilizers proved beneficial. It may be concluded that acid strawberry soils for best results should be fertilized with base-forming fertilizers or should be limed to maintain a pH of about 6.0. Strawberry plants did not thrive in soils having a pH of 4.5 or lower.

The effect of offsetting fertilizer acidity was not pronounced with the potato, a decidedly acid-tolerant crop, for just as high yields were obtained with acid-forming as with neutral fertilizer mixtures.



## EFFECT OF FERTILIZERS ON COTTON ROOT ROT

Investigations on blackland soils in Texas subject to cotton root rot show the importance of effecting early maturity with certain fertilizer treatments as a means of avoiding losses due to progressive killing of plants by root rot. On such soils as the Wilson clay loam, applications of fertilizer mixtures high in nitrogen were effective in reducing the rate of plant mortality caused by this disease. Phosphate fertilizers with a high ratio of phosphoric acid to nitrogen increased the rate of plant mortality in the early season, but such effects were not observed on the Houston soils under continuous cotton culture. With cotton following sorghum, nitrogenous fertilizers were effective in reducing the rate of plant mortality as compared with unfertilized cotton. Both field and laboratory studies indicate that the markedly reduced rate of plant mortality associated with the application of nitrogen fertilizers to cotton following sorghum may be attributed to a greater activity of soil organisms in the presence of actively decomposing organic matter and liberal quantities of available nitrogen.

## IMPROVEMENT OF LIGHT SOILS

The maintenance of fertility and economical crop production on light sandy soils are most effectively accomplished, as demonstrated by lysimeter and field experimentation, by allowing crop residues to decompose on the surface of the soil rather than by incorporating them in the soil. Field, lysimeter, and chemical studies indicate that the periodical addition of quickly available nitrogen compounds, supplemented with phosphoric acid and potash, is essential to any method of restoring these sandy soils to profitable farming.

## CALCINED PHOSPHATE TESTS

Recent investigations in cooperation with the Bureau of Chemistry and Soils have shown that when rock phosphate is heated to a sufficiently high temperature in the presence of water vapor the fluorine it contains is largely driven off and the phosphoric acid rendered available to plants. Cooperative growth tests in the greenhouse with millet, Sudan grass, and other crop plants as indicators have shown that calcined phosphate compares favorably as a nutrient material with superphosphate and other sources of phosphoric acid.

## MAGNESIUM DEFICIENCY

Fertilizer studies on prominent soil types have definitely shown that modern fertilizer usage may tend to deplete the soil of basic compounds, chiefly calcium and magnesium. Serious magnesium deficiencies have been noted in a number of important potato-producing sections. Cooperative investigations have shown that the remedy lies either in the addition of an available magnesium compound to the fertilizer or in the separate application of dolomitic limestone to the soil. The importance of supplying available magnesium in the fertilizer has been called to the attention of fertilizer manufacturers, and its inclusion in the fertilizer mixtures is becoming an established practice.

## SOIL MICROBIOLOGY

CHARLES THOM, *in charge*

## SOIL AMOEBAE

Progress was made during the year in the study of the activity of the various types of amoebae living in the soil. In studying a recently described new slime mold (*Dictyostelium discoideum*) it has been possible to separate the amoeboid stage from associated bacteria. A study of the action of these organisms on various types of saprophytic and pathogenic bacteria is now possible.

## CELLULOSE-DECOMPOSING MOLDS

Studies of cellulose-decomposing molds common in the soil have shown that such forms as *Trichoderma* sp. and *Chaetomium* sp., common everywhere in decaying material, are capable of complete break-down of the types of fiber used in ropes and cordage as well as the cotton of textiles. A paper describing the use of *Chaetomium* in testing the effectiveness of mildew-proofing agents was published during the year.



## LEGUME INOCULANTS

Inspection of 750 samples of legume inoculants showed over one-third of them to be unsatisfactory. The manufacturers were notified in writing, and notices to the Extension Service and to distributors stopped the distribution of some of the poorer products. Assurance of changes and improvements have been received from most of the manufacturers.

## NITROGEN FIXATION BY AZOTOBACTER

The significance attached to *Azotobacter* as an agent in nitrogen fixation emphasizes the desirability of studies of its physiology and distribution. Bacteriologists in many countries have been testing for its presence and significance by the use of nitrogen-free mannitol media. In the course of surveys covering some of the black soils of the western plains, cultures of one species (*Azotobacter chroococcum*) which cannot use mannite have been found so frequently as to invalidate all previous surveys based upon mannite media alone. Some soils indicated as lacking *Azotobacter* entirely by previous methods are found to have an abundance of the organism when sucrose, dextrin, or starch are substituted for mannitol. Both the mannite-negative and the mannite-positive kinds are found in the same soil in other areas. In spite of a vast amount of effort, knowledge of this group of species as they grow in the field remains deficient at many points.

## EFFECTS OF SOIL MICROORGANISMS ON TRACE ELEMENTS

Progress in the study of the effects of soil microorganisms upon elements present or added in very small amounts was made in the case of selenium. Among results, *Pseudomonas fluorescens*, one of the most active agents in the decomposition of plant remains, has been found to produce a volatile compound from metallic selenium, from the dioxide, and from potassium selenate, but not from sodium selenate, in culture media. Many other organisms were found to be active.

## SUGAR PLANT INVESTIGATIONS

E. W. BRANDES, in charge

## SUGARCANE

## NEW VARIETIES

Progress in developing disease-resistant varieties of sugarcane more economical in production of sugar and which meet certain accessory requirements is indicated by the release by the Bureau of two new varieties—C. P. 28/11 and C. P. 28/19—in the fall of 1934. More than 4,000 tons of cane of these varieties, propagated in cooperation with the Louisiana Agricultural Experiment Station and the American Sugar Cane League, was distributed in Louisiana. Because of the definite need for earlier maturing varieties, these are valuable supplements to varieties now available for commercial culture. They are satisfactory in yield of cane and sugar, mature at a comparatively early date, and possess favorable ratooning qualities, characteristics which (especially in the case of C. P. 28/19) make them suitable for culture in place of the early maturing variety P. O. J. 234. The unsatisfactory ratooning of P. O. J. 234 has rendered its culture extremely hazardous.

Agonomic trials in Georgia and Mississippi have shown that the variety Co. 290, which was released for commercial culture in Louisiana in the fall of 1933, is suitable for culture in the States in which cane is grown for the production of sirup only. Yields of sirup from this variety equal or exceed those from the varieties Cayana, P. O. J. 213, and C. P. 807, which are now extensively grown.

## SUGARCANE-SORGO HYBRIDS

From hybrids successfully produced by the Bureau between sugarcane and sorgo it is hoped to develop high-yielding, disease-resistant hybrids possessing the early-maturing qualities of sorgo and the high sugar-yielding qualities of sugarcane. Selections from hybrids developed in India a few years ago between sugarcane and grain sorghum are said to mature in 6 months. The Bureau's

work marks the first time that sugarcane-sorgo hybrids have been produced, and their successful production represents a scientific achievement aside from any practical possibilities. Several of the seedlings produced in 1933-34 combine the characteristics of the two parents so as to be encouraging. These, together with several hundred seedlings obtained from some 22 intergeneric hybrids made in 1934-35, are now being studied. A forecast of potential practical value of this work would be premature. No plants are available in excess of the needs of the Department, and it is unlikely that any planting material will be available for distribution for several years even if the experiments are successful.

#### BIOLOGY OF THE RED ROT FUNGUS

Comparative laboratory studies and infection experiments have demonstrated the existence in the United States of at least two specialized forms of the red rot fungus (*Colletotrichum falcatum*) attacking sugarcane. The forms differ in color and texture of mycelium in culture and also in virulence on commercial varieties. Both occur in Louisiana, but the light colored, more destructive form predominates and has been largely responsible for the almost complete failure of the formerly leading variety, P. O. J. 213. In Mississippi, Georgia, and northern Florida, where this variety is still successfully cultivated, the dark, less virulent type has been isolated almost exclusively. The discovery of specialized forms renders the problem of obtaining resistance more difficult. On the other hand, it will enable adequate testing of promising new varieties for both and thereby promote avoidance of further economic losses from this disease.

#### INHERITANCE OF DISEASE RESISTANCE

Extensive trials of large seedling families representing diverse interspecific and intervarietal crosses for resistance to mosaic and red rot have yielded information of importance for eventual production of superior, fully resistant varieties. Crosses between susceptible noble varieties and various collections of the immune wild cane (*Saccharum spontaneum*) show incomplete dominance of mosaic resistance in the  $F_1$  generation; and successive back-crossing of immune offspring to susceptible female parents, in case of several intervarietal crosses, has greatly increased the percentage of susceptible seedlings.

#### SUGAR BEETS

##### ROTATION INFLUENCING STAND AND YIELD

The stands and consequent yields of sugar beets have been found to be better when the beet crop follows corn in the rotation than when it follows sweet-clover or alfalfa. This is at variance with established practice in many localities. The unfavorable stands arise because the two legumes, highly valuable as they are for their beneficial effects on the soil, alter the soil flora by increasing the pathogenes which cause damping off of sugar beets, whereas corn has a definite sanitation effect by decreasing these pathogenes. Experiments with Michigan, Ohio, Virginia, and Colorado soils and field observations in many States indicate that these relationships are general in occurrence.

##### VARIETIES RESISTANT TO LEAF SPOT

Continued favorable showing of inbred lines of beets selected for leaf spot resistance, and the demonstrated superiority, under leaf spot conditions, of certain synthetic varieties made by intercrossing these lines, warrant their increase on considerable scale looking toward their replacing the commercial brands now in use in the areas where leaf spot is a factor. Under epidemic leaf spot conditions some of these synthetic varieties equaled in tonnage the performance of the yield types while equaling in sucrose percentage the performance of the so-called sugar types.

##### IMPROVED CURLY TOP RESISTANT VARIETIES

The curly top resistant variety U. S. No. 1, under conditions of severe curly top in 1934, greatly alleviated losses in those fields in western Colorado, Utah, and Idaho where late planting, water shortage, or lack of proper culture were



not factors. In 11 grower-test plantings the variety produced as an average 7.04 more tons of beets per acre, of satisfactory quality, than commercial brands used for comparison. These results are in accord with independent reports by beet-sugar companies, which show that in 8 districts in 4 States the U. S. No. 1 variety produced on the average 13.35 tons of beets per acre compared with 5.47 for the commercial brands. Approximately 30,000 acres were planted with this variety in 1934, and about 75,000 acres in 1935, some districts using it almost exclusively.

#### STUDIES OF CURLY TOP VIRUS

The curly top virus, as brought to the beet field by the leaf hopper, has been shown in some seasons to be largely of attenuated type, but as the season progresses severe curly top appears in the field, apparently because of a building up of virulence. Previous work had indicated that certain susceptible weeds could restore the virulence of attenuated virus. Laboratory evidence has now been secured that young sugar beet plants may also function in this manner under some conditions.

Curly top virus when subjected to certain conditions in the plant or exposed to certain substances, including plant extracts, has failed to produce infection and is referred to as inactivated. It was discovered that after plant extracts had been stored for some days their action on the virus was to increase its activity rather than to inactivate it as at first. From tests with electrolytes, sodium citrate in certain concentrations was found to increase greatly the amount of free virus in a given sample of juice from diseased plants. The phenomenon previously called inactivation now appears to be one of fixation or adsorption and to be reversible and influenced by hydrogen-ion concentration. This leads to new concepts on the relation of the virus to the cell contents and to plant tissues and may throw light on virus localization in the plant and its general behavior in disease production.

Recent studies have shown that curly top virus occurs in high concentrations in seed balls approaching maturity on diseased plants. In young seed balls apparently it is absent or present in very small quantities. The virus in the mature fructifications is restricted to the perisperm and apparently does not enter the embryo. Seed balls having a very high virus content germinated readily but always produced healthy seedlings. Seed balls kept dry for 2 months showed greatly reduced virus, and no virus was obtained from those stored at room temperature for 3 months.

#### TOBACCO AND PLANT NUTRITION

W. W. GARNER, *in charge*

##### FACTORS INDUCING TOBACCO LEAF SPOT EPIDEMICS

Wildfire and blackfire have long been known as destructive leaf diseases of tobacco likely to appear in late summer following severe rainstorms. Studies recently completed have given a much clearer understanding of the factors causing severe outbreaks after such storms.

Tobacco leaves ordinarily are highly resistant to invasion by the bacteria causing these diseases, and, while infection occurs readily, the lesions remain small. However, if the leaves are first subjected to a strong water spray they develop water-soaked areas, and when in this condition invasion of tissues proceeds rapidly and large areas are killed in 2 or 3 days. Cultural practices known to influence the development of leaf spot did so by modifying the susceptibility of the leaves to water-soaking. Thus, high nitrogen and low potash fertilization and low topping increased the susceptibility to water-soaking. Also, fresh mechanical injuries or disease lesions made leaves easier to water-soak; wind in connection with rain tended to turn up the leaves, exposing the under surface, and favoring water-soaking. The water-soaking to be effective in promoting the development of disease must persist 24 hours or more, hence short violent storms did not produce epidemic leaf spot unless followed by rains which maintained the water-soaked area.

It is concluded that control of these diseases will be dependent on (1) eliminating the bacteria, (2) protecting the plants from storms (as by growing the crop under cloth), or (3) developing plants resistant to disease or to water-soaking.



## BREEDING TOBACCO FOR DISEASE RESISTANCE

Tobacco varieties grown in the United States are generally susceptible to diseases causing heavy losses. Encouraging progress has been made in finding strains of tobacco from foreign sources that are resistant especially to Granville wilt and downy mildew or blue mold. After suitable resistant lines are established it will remain to develop varieties that combine resistance with high quality.

## NICOTINE CONTENT

Experiments were conducted in 1934 in cooperation with State agricultural experiment stations at selected points in California, Oregon, and in several tobacco-growing sections of the East, with strains of *Nicotiana rustica* developed in previous years in comparison with standard varieties of ordinary tobacco. This species when topped and suckered, as a rule, gave a considerably larger output of nicotine per acre than did ordinary tobacco. Under favorable conditions it produced 150 to 200 pounds of nicotine per acre. While the tonnage of dry matter was lower than that of ordinary tobacco, the larger percentage of nicotine more than compensated for this difference. It is believed that better types of *N. rustica* can be developed by breeding.

## BORON DEFICIENCY IN TOBACCO

When relatively pure chemicals were used in a typical light sandy tobacco soil at Upper Marlboro, Md., to supply the six fertilizer elements, nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur, symptoms of boron deficiency became apparent after growing tobacco continuously for 5 years. The deficiency was corrected by the use of 5 pounds of boric acid per acre.

## TOBACCO FOLLOWING WEED GROWTH

In view of the excellent results previously observed with tobacco grown after a natural weed fallow, it became a matter of considerable importance to determine whether any particular weed species occurring under these conditions possesses special merit. In the early years the weeds were transplanted, but it has now been found possible to grow a satisfactory cover crop of them from seed in the desired locations. Relatively pure stands of six species of weeds commonly occurring in natural weed fallow in the Marlboro, Md., area were tested in comparison with bare fallow, the natural weed fallow, lespedeza, and annual sweetclover. Best results were obtained with tobacco growing after natural weed fallow consisting of mixtures of the weeds. The crop grew well after the pure cultures of ragweed, horseweed, and partridge-pea. Unsatisfactory growth of tobacco resulted when lambsquarters, wild bean, rabbitfoot clover, lespedeza, and annual sweetclover preceded the crop.

## CHEMICAL ELEMENTS ESSENTIAL FOR NUTRITION OF PLANTS

Studies on the improvement of methods for determining which chemical elements are essential in minute quantity for plant growth have been continued, with *Aspergillus niger* as the test plant. Progress has been made in removing certain of the "trace" elements that always occur as an impurity in the chemicals of which the nutrient solution is composed. Treatment of the nutrient solution with calcium carbonate has been found suitable for removal of certain of these elements under a wide variety of conditions. When phosphorus was omitted from the solution, the *Aspergillus* produced only 0.10 percent of the normal yield; when nitrogen was omitted the percentage was 0.2; without potassium, 5.5; without magnesium, 0.5; without sulphur, 2.4. With corresponding deficiencies in the trace elements that are required only in minute quantities the percentages of normal yield were, without iron, 0.9; without zinc, 1.4; without copper, 35.2; and without manganese, 38.5. The need of still another trace element for *Aspergillus niger* has been discovered recently. The yield is but 65.5 percent of the normal if the organism is grown in a nutrient solution as free from molybdenum as possible. It is assumed that the degree to which growth is depressed on withholding any of the above essential elements from the nutrient solution depends on the thoroughness with which it has been possible first to remove them from the nutrient solution.

## WESTERN IRRIGATION AGRICULTURE

C. S. SCOFIELD, *in charge*

### IRRIGATED LANDS SUPPLEMENT FEED SUPPLY

Vast areas of grazing lands surround many irrigation projects in the arid and semiarid West, and a substantial part of the Nation's meat supply originates in the breeding herds on these ranges. However, these areas frequently are subject to droughts, sometimes of great severity. Before the advent of irrigated agriculture there was no supplementary source of feed upon which to draw, and severe losses of livestock resulted. With the development of irrigated lands the livestock industry has been materially stabilized and the disastrous effects of the recurring droughts have been greatly reduced. A more general recognition and efficient use of irrigated lands to supplement and stabilize the livestock industry on the dry lands may be expected to aid still further in developing a prosperous agriculture throughout the West. The investigations of the Division of Western Irrigation Agriculture are concerned with improving efficiency in the use of these lands and the water used on them.

### INJURIOUS CONCENTRATION OF SOIL SOLUTION

It has long been recognized that the dissolved salts carried in irrigation waters tend to accumulate in the soil solution of irrigated land, because both evaporation and plant absorption remove water but not salts. Recent investigations appear to show that there is serious depression of growth with concentrations much lower than those that cause the death of crop plants. This depression of growth escapes notice because it is often not accompanied by the more obvious symptoms of acute salt injury.

### WATER REQUIREMENTS OF CROPS

Agronomic investigations relative to the water requirements of the more important irrigated staple crops have been under way for 3 years at two field stations in cooperation with the Bureau of Agricultural Engineering, to supply the need for precise information as to how much water is required to produce such crops as alfalfa, corn, the cereals, sugar beets, and cotton. The data thus far accumulated have contributed substantially to the knowledge of this important subject. Not only are such data useful in supplying information as to the comparative water requirements of field crops, but also in showing how, through the adequate use of water, the danger of crop injury from salinity may be avoided.

### SALINITY CONDITIONS IN THE RIO GRANDE

An investigation is being made of salinity conditions in the Rio Grande, in cooperation with certain Federal and State agencies. The waters of this stream are extensively used for irrigation in New Mexico and Texas, and the drainage water from the irrigated areas is returned to the main stream. Because a large part of the irrigation water is used by crop plants or lost by evaporation, the smaller volume of the returned drainage water contains most of the original dissolved salts, which increase the salinity and impair the value of the main stream for subsequent use for irrigation on lands that lie downstream. Data attained at 10 gaging stations from the northern line of New Mexico to the mouth of the river show the quantity of water and the quantity and quality of the dissolved salts passing each station.

### SUBSOIL WATERS

In many irrigated sections the productivity of the soil is impaired by a zone of saturation in the subsoil. This condition is also referred to as a high water table or as water-logging of the subsoil. It may be caused by the excessive use of irrigation water, but investigations at three field stations have shown that the chief cause lies in the percolation of water from the irrigation ditches rather than from excessive application to the fields.



## BORON IN IRRIGATION WATER

Investigations concerning injurious concentrations of boron in irrigation waters in California and Nevada have shown that it is possible to obtain improvement in conditions through community action. As a result, such action was initiated during the year in four districts in California where serious boron injury occurs. The objective of community cooperation is to eliminate from the irrigation supplies those contributions that are most highly contaminated with boron and thus to reduce the boron content of the water supply. Effective efforts in this direction have been made possible by the general recognition by orchardists of the nature and evidence of boron injury to crop plants and by the cooperation of the local extension agents.

## ARLINGTON EXPERIMENT FARM

E. C. BUTTERFIELD, *superintendent*

The Arlington Experiment Farm, across the Potomac River from Washington, D. C., is not a farm in the general sense of the term but is rather a large out-of-doors field laboratory, approximately 400 acres in extent, equipped with 105 buildings as barns, shops, laboratories, and greenhouses, provided with special facilities to meet the requirements of research. Although the farm is administered by the Bureau of Plant Industry and most of the work forms a part of that Bureau's research, a number of projects are carried on there by other bureaus of the Department and a few by other branches of the Government.

Among the more important activities of the year in the Bureau's projects were the following: Agronomic and pathologic investigations of cereals; studies of various types of mulches; experimental culture of medicinal, insecticidal, and oil plants; forage crop and disease investigations, including lespedeza, soybeans, sweetclover, red clover, alfalfa, vetch, and crotalaria; studies of resistance of different strains of chestnuts to blight and other diseases; cultural, breeding, pathological, and storage studies of fruit and vegetable crops; experiments in the control of mushroom diseases; studies of the germination and identity of seeds; experimental work on diseases of sugar beets and sugarcane; growing sugarcane plants in quarantine; and tobacco and plant-nutrition investigations, including studies on effect of length of day on flowering, fruiting, and other features of plant growth.

## EXPERIMENTAL GREENHOUSES

J. W. BYRNES, *in charge*

The project of experimental greenhouses has continued its service of maintaining the greenhouses on the Department grounds, supplying facilities for plant research by the Bureau staff, propagating plants, providing ornamental and flowering plants for the main building and adjacent grounds, and general horticultural care of the grounds. Thirty-two greenhouses were maintained for experimental work with a wide range of plants, both economic and ornamental. Plants were supplied to ornament the patio of the Administration Building. The thirty-third annual chrysanthemum show (Oct. 31 to Nov. 7, 1934) and the twenty-second annual amaryllis show (Mar. 29 to Apr. 5, 1935) were features of special interest and attracted large numbers of visitors. The breeding work with floral plants has resulted in some fine new varieties. This year 3 new varieties of carnations (Rigoletto, Mavourneen, Carlotta), 5 new varieties of pompon chrysanthemums (Navajo, Marie Brilliant, Antares, Aldebaran, Pleiades), and 1 new variety of Japanese chrysanthemum (Beverly T. Gallo-way) were supplied to commercial growers for test and dissemination.

## PUBLICATIONS, EXTENSION, ETC.

During the year 166 publications (154 new and 12 revised) contributed by the Bureau were issued in the Department series. These comprised 79 papers in the Journal of Agricultural Research, 19 technical bulletins, 26 farmers' bulletins and leaflets, and 42 other items, semitechnical or popular. In addition there appeared in outside scientific, agricultural, and commercial publications 382 articles written by members of the Bureau's staff on various subjects



related to its field of activity. A list showing the new official publications and the outside contributions is appended.

The Bureau continued to cooperate with the press service and the radio service in preparing and furnishing informational material.

Cooperation was also continued with the Department's Extension Service and the State agricultural extension services in making available the practical benefits of research and in helping farmers to cut production costs, grow higher grades of the various crops, and improve the keeping quality and marketability of their products. Three extension specialists dealing respectively with plant-disease control, horticulture, and agronomy are cooperatively maintained.

## LIST OF PUBLICATIONS

### CEREALS

- Hybrids of wheat, rye, *Aegilops* and *Haynaldia*. By W. J. Sando. Jour. Heredity 26: 229-232.
- Inheritance of rye crossability in wheat hybrids. By J. W. Taylor and K. S. Quisenberry. Jour. Amer. Soc. Agron. 27: 149-153.
- Seed situation in the Great Plains. By S. C. Salmon. Seed World 37(1): 7-9.
- Treat seed grain. By A. G. Johnson, R. J. Haskell, and R. W. Leukel. U. S. Dept. Agr. Misc. Pub. 219.
- A new type of nursery thresher. (Note.) By O. A. Vogel and A. J. Johnson. Jour. Amer. Soc. Agron. 26: 629-630. (With Pacific Northwest Soil Erosion Sta.)
- Cereal disease forecasting. By H. B. Humphrey. World's Grain Exhib. and Conf. Regina, Canada, 1933, Proc. 2: 214-219.
- Keys to aid in the identification of the more important foot rots of winter grains in the Pacific Northwest. By R. Sprague. Oreg. Agr. Expt. Sta. Circ. Inform. 99. (In cooperation. Mimeographed.)
- Cercospora foot rot of winter cereals. By R. Sprague and H. Fellows. U. S. Dept. Agr. Tech. Bul. 428. (With Oreg., Wash., and Idaho Agr. Expt. Stas.)
- Preliminary note on another foot rot of wheat and oats in Oregon. (Note.) By R. Sprague. Phytopathology 24: 946-948. (With Oreg. Agr. Expt. Sta.)
- Cereal rust parasitism: Its relation to water economy, yield, and quality of the host plant. By H. B. Humphrey. Roy. Soc. Canada Trans. ser. 3, 28 (sect. V): 153-164.
- The rusts of cereal crops. By H. B. Humphrey, E. C. Stakman, E. B. Mains, C. O. Johnston, H. C. Murphy, and W. M. Bever. U. S. Dept. Agr. Circ. 341. (With Bur. Ent. and Plant Quarantine.)
- A portable rust-inoculation chamber. (Note.) By H. B. Humphrey and F. A. Coffman. Phytopathology 25: 279-281.
- Woinovicia graminis* as a very weak, secondary parasite of winter cereal crops. By R. Sprague. Phytopathology 25: 405-415. (With Oreg. and Wash. Agr. Expt. Stas.)
- The diastatic activity of whole wheat and some other cereal grains as determined by the Blish-Sandstedt method. By D. A. Coleman, S. R. Snider, and H. B. Dixon. Cereal Chem. 11: 523-531. (With Bur. Agr. Econ.)

### BARLEY

- Fifteen years of selection in six varieties of barley. By M. N. Pope. Jour. Amer. Soc. Agron. 27: 142-148. (With Idaho Agr. Expt. Sta.)
- Complementary factors in barley giving a lethal progeny. By G. A. Wiebe. Jour. Heredity 25: 273-274. (With Calif. Agr. Expt. Sta.)

- The lateral flowers of two-rowed barley. Varying levels of fertility possibly associated with plant vigor. By H. V. Harlan and M. L. Martini. Jour. Heredity 26: 109-113. (With Idaho Agr. Expt. Sta.)
- Yields of barley in the United States and Canada, 1927-31. By H. V. Harlan, P. R. Cowan, and L. Reinbach. U. S. Dept. Agr. Tech. Bul. 446. (With Canada Expt. Farms.)
- Barley diseases controlled by seed treatment. By R. W. Leukel and V. F. Tapke. U. S. Dept. Agr. Misc. Pub. 199.

### CORN

- Chromosomes in hybrids between *Euchlaena perennis* and *Zea mays*. By A. E. Longley. Jour. Agr. Res. 48: 789-806.
- A tetraploid hybrid of maize and perennial teosinte. By G. N. Collins and A. E. Longley. Jour. Agr. Res. 50: 123-133.
- Cytogenetics of tetraploid maize. By L. F. Rendolph. Jour. Agr. Res. 50: 591-605. (With N. Y. State Col. Agr., Cornell Univ.)
- Linkage relations of the  $A_2a_2$  factor pair in maize. By M. T. Jenkins. Jour. Amer. Soc. Agron. 26: 719-720. (With Iowa Agr. Expt. Sta.)
- The effect of inbreeding and of selection within inbred lines of maize upon the hybrids made after successive generations of selfing. By M. T. Jenkins. Iowa State Col. Jour. Sci. 9: 429-450.
- A comparison of reciprocal top crosses in corn. By R. R. St. John. Jour. Amer. Soc. Agron. 26: 721-724. (With Ind. Agr. Expt. Sta.)
- The wheat and how of hybrid corn. By F. D. Richey. U. S. Dept. Agr. Farmers' Bul. 1744.
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## REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF PUBLIC ROADS,  
Washington, D. C., September 1, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1935.

Sincerely yours,

THOMAS H. MACDONALD, *Chief.*

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Road construction work supervised by the Bureau of Public Roads during the fiscal year 1935 continued at the high volume of the preceding year that far exceeded the amount in any previous year. Work was done almost entirely with the grant of \$400,000,000 under authority of the National Industrial Recovery Act of June 1933 and the grant of \$200,000,000 under the Hayden-Cartwright Act of June 1934, but small amounts were available from Federal-aid and emergency authorizations of previous years.

The year began with the volume of road construction with Federal funds and employment at an all-time peak, made possible by the funds provided under the National Recovery Act. Construction activity continued large in volume through the fall months, and many projects were brought to completion. With the beginning of the construction season of 1935 work began in considerable amount on projects carried on with Hayden-Cartwright funds but not in sufficient volume to equal the record in the same months of the preceding year, as there was a decrease in the funds available.

The roads built have been constructed under conditions similar to those prevailing last year. They consist of sections on the Federal-aid highway system, extensions of the system into and through cities, and important secondary or feeder roads and sections of main highways through the national forests, parks, and public lands.

In all the work the primary motive has been to increase employment, and other considerations have been of secondary importance.

### EMPLOYMENT ON ROAD WORK

Efforts to increase employment through the use of Federal funds for road construction began in 1930 when Federal aid for the fiscal year 1931 was increased from the \$75,000,000 previously authorized to \$125,000,000, and a like amount was authorized for each of the fiscal years 1932 and 1933. Subsequently emergency funds of \$80,000,000 and \$120,000,000 were advanced to the States and were used largely in matching Federal-aid funds.

The suitability of road work as a relief measure and the magnitude of the employment problem were recognized in the National Recovery Act of June 16, 1933, under which \$400,000,000 was authorized as a direct grant to the States and \$50,000,000 was authorized for roads in federally controlled areas.

The employment produced by these various acts is shown in table 1. Each year shows an increase in employment over the preceding year, and winter employment has been furnished on a scale considered impossible of attainment a few years before.

TABLE 1.—*Comparison of employment during the fiscal years 1932, 1933, 1934, and 1935 on all Federal and Federal-aid highway construction and on all Federal and State road work, including State maintenance, by months*

Month	Men employed on all Federal and Federal-aid highway construction				Total men employed on all Federal and State highway construction and maintenance			
	1932	1933	1934	1935	1932	1933	1934	1935
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
July.....	164,708	81,042	129,205	335,223	385,349	305,372	332,277	549,203
August.....	151,418	89,346	111,211	297,224	389,949	333,403	329,813	531,034
September.....	116,100	122,193	115,047	247,880	356,617	374,405	337,973	498,151
October.....	88,869	124,106	154,016	210,079	330,104	373,246	384,029	450,322
November.....	62,466	129,933	185,860	201,046	289,316	371,667	420,069	426,603
December.....	35,991	98,271	174,358	147,101	244,971	290,465	362,031	323,700
January.....	29,518	75,498	154,154	96,594	229,189	266,443	315,989	240,414
February.....	26,673	78,215	156,814	81,257	218,218	255,256	306,090	221,406
March.....	28,008	95,704	144,053	90,999	211,549	279,213	296,265	217,539
April.....	42,205	122,256	187,657	123,063	245,843	299,882	345,278	282,740
May.....	59,008	139,831	271,972	167,535	259,615	330,138	466,504	331,000
June.....	71,772	152,276	336,414	193,263	280,636	359,605	545,013	362,339
Total (man-months)....	876,736	1,308,671	2,120,761	2,191,264	3,441,356	3,839,095	4,441,331	4,434,451

The preceding fiscal year closed with 336,414 man-months of direct-job employment in June on work involving Federal funds—the largest employment yet recorded in any single month. With the beginning of the fiscal year 1935 there began a gradual decline in employment, resulting from the completion of projects under the program planned under the National Recovery Act.

The Hayden-Cartwright Act of June 18, 1934, had provided \$200,000,000 as a direct grant to the States on substantially the same terms as the National Recovery Act, and also \$24,000,000 for roads in national forests, national parks, and other areas under Federal control. These authorizations were not immediately reflected in employment on new projects since it was necessary for each State to prepare a program, make surveys, and prepare plans. Employment during the first 5 months of the year, although declining, far surpassed that of any similar period in past years. It was not until December that employment dropped below that of the same month of the preceding year. This decline continued through February, but in March new projects financed with Hayden-Cartwright funds reversed the trend, and direct employment climbed to 193,263 men at the close of the year. This is considerably below the 336,414 men employed in June 1934, and resulted from the decrease in funds available.

The average full-time employment was 182,605 men throughout the year. The number of men actually employed was somewhat greater than this, as contractors' pay rolls, because of labor turn-over, show about one-third more names than are reported as being required for normal operation. Therefore approximately 244,000 men were given direct-job employment in road work in the average month. To this should be added the indirect employment supplied in the production and transportation of materials and equipment. It is estimated that such indirect employment required by the work done has averaged approximately 1.4 times the direct employment, and on this basis the indirect employment afforded during the fiscal year 1935 is estimated at 3,067,800 man-months, which, added to the direct employment, results in a total of approximately 5,259,000 man-months for the year.

Table 1 also shows that Federal and Federal-aid road-construction employment supervised by the Bureau continues as a large proportion of the total employment afforded by all Federal and State highway construction and maintenance work since 1932, increasing from about one-fourth of the program in 1932 to one-third in 1933 and nearly one-half for the past 2 years.

Table 2 gives details of the 1935 Federal and Federal-aid employment by months, segregating the numbers of workers employed on the various classes of Federal and Federal-aid work supervised by the Bureau, and giving separately the numbers employed on independent State construction and maintenance. The total figures were affected by the decrease in State maintenance employment and by the drop in Federal road construction due to the partial completion of the Public Works highway program.

TABLE 2.—Direct job employment of men during the fiscal year 1935 on the several classes of Federal and Federal-aid road construction and State road construction and maintenance

Month	Men employed on road construction—												Men employed on Federal road maintenance by State highway departments	Total men employed on Federal and State road construction and maintenance	
	In whole or in part with Federal funds—														
	Without Public Works funds					With Public Works funds, acts of June 16, 1933, and June 18, 1934									
	National-forest highways	National-park highways	Public-lands highways	Federal-aid highways	On Federal-aid system outside of municipalities	On extensions of Federal-aid system into municipalities	On secondary or feeder roads	National-forest highways	National-park highways	Public-lands highways	Loan-and-grant highways	National-work-relief highways			With State funds only, on State highways
July-----	1,067	474	-----	3,489	127,669	71,623	75,634	6,550	6,038	1,040	10,679	30,960	45,478	168,502	549,203
August-----	689	568	-----	2,676	109,269	62,388	65,061	6,601	6,212	1,152	13,044	29,564	53,540	180,270	531,034
September-----	501	581	-----	1,936	86,536	48,639	54,101	6,009	6,108	1,149	14,983	27,577	61,865	188,406	498,151
October-----	956	396	100	1,459	73,632	34,539	49,630	5,091	5,812	1,249	14,670	22,545	71,008	169,235	450,322
November-----	1,454	333	228	2,008	69,299	29,196	47,957	3,325	4,875	1,650	16,346	25,375	66,106	159,451	426,603
December-----	1,354	113	178	1,512	50,962	18,624	36,941	1,341	2,341	593	11,276	21,866	41,919	134,680	323,700
January-----	961	83	126	626	35,620	10,861	21,421	1,697	1,428	457	6,448	17,866	23,537	120,283	240,414
February-----	678	110	134	307	30,526	9,612	15,614	415	913	338	3,561	19,049	17,940	122,209	221,406
March-----	758	111	125	412	34,305	11,765	17,539	505	854	168	3,960	20,497	18,391	108,149	217,539
April-----	1,193	140	179	449	46,532	18,038	25,785	706	1,312	51	8,083	20,595	24,163	135,484	282,740
May-----	1,864	154	308	1,067	65,692	25,768	37,869	961	2,535	130	12,176	19,011	27,924	135,541	331,000
June-----	2,880	548	480	880	76,906	31,517	46,654	1,352	3,251	183	12,485	16,127	30,823	138,253	362,339



### CLASSES OF WORK SUPERVISED BY THE BUREAU

The road construction work supervised by the Bureau during the fiscal year was of several classes supported by funds appropriated by a number of different acts.

The major portion of the program was financed by funds authorized as direct grants to the States by the National Industrial Recovery Act for improvements on the Federal-aid highway system and its municipal extensions and on secondary or feeder roads and by the authorization in the Hayden-Cartwright Act made for similar purposes.

A relatively small part of the program was provided for by the unexpended balances of Federal-aid appropriations authorized over a period of years ended with the fiscal year 1933, and the emergency authorization of 1932. As in the preceding fiscal year, no Federal aid was provided for 1935, but the policy of Federal aid was resumed by an authorization in the Hayden-Cartwright Act for the fiscal years 1936 and 1937, and an apportionment to the States for 1936 has been made.

Other work in special areas for which the Federal Government was responsible consisted of: (1) The improvement of national-forest highways and (2) the improvement of highways through the public lands of the United States, both of which classes were under the supervision of the Department; and (3) the improvement of national-park highways. The national-park highways were constructed with appropriations made to the Interior Department, but under an interdepartmental agreement were supervised by the Bureau of Public Roads. The three classes of work were supported mainly by appropriations made in the National Industrial Recovery Act and the Hayden-Cartwright Act.

Another class of road work, an outgrowth of the recovery legislation, begun last year and expanded during the current year, consisted of projects financed under the loan-and-grant provisions of the National Industrial Recovery Act, which, after approval by the Public Works Administration, were placed by that body under the supervision of the Bureau of Public Roads.

Supervision of work-relief construction in cooperation with the State highway departments, begun in the preceding year, was continued on an enlarged scale. The workers on these projects were selected and paid by the Federal Emergency Relief Administration, and funds for materials and equipment were provided by the Public Works Administration.

The year's program included also an inconsequential volume of improvement under several appropriations for the reconstruction of roads damaged in several States.

The year's activities in connection with each of these classes of work are reported separately hereafter.

Under the Emergency Relief Appropriation Act of April 8, 1935, funds were allocated for highway improvement and the elimination of hazards at grade crossings by direct grants to the States. In this work even greater emphasis than in the past is to be laid on the selection of projects so as to provide the greatest employment of labor. Administrative procedure to attain this end was being developed at the close of the year.

### ALL CLASSES OF WORK ADMINISTERED WITH EMPLOYMENT AS PRINCIPAL OBJECTIVE

To carry forward the paramount work-relief purpose of the different recovery acts, conditions were imposed in the preceding year by rules and regulations, issued with the approval of the Special Board for Public Works, for the administration of public-works appropriations that had the effect of increasing employment and of distributing the benefits of the expenditure over a wide area closely related to the need for employment. These policies were continued with some changes in procedure resulting from experience in 1934.

Human labor instead of machinery was used where practicable and to the public advantage. However, machine methods were used on certain classes of work, and an effort was made to avoid serious jeopardy to the effective road-machinery industry. The approval of varied types of construction maintained a desirable balance between labor directly employed at the site of the work and men employed in materials, equipment, and transportation industries.

On work of the lower types, encouraged on the secondary and feeder roads where traffic density would permit, the direct local employment formed a large part of the total. In the higher types of improvement, approved for main rural roads and streets in cities, the element of indirect employment was greater.

On extensions of Federal-aid highways across cities reasonable minimum expenditures were required, thereby increasing work-relief opportunities in centers where unemployment was concentrated. The requirement that not less than 25

percent of the funds be used on secondary or feeder roads insured large rural employment.

An increase in the number of individuals employed resulted from the limitation of hours of work; and by an increase in hourly wage an effort was made to compensate individuals for the reduction of their hours of work. This result was accomplished by requiring the various State highway departments to establish minimum-wage rates sufficient to provide a standard of living in decency and comfort considering the reduced hours of work and the other conditions existing.

### ADMINISTRATIVE CHANGES MADE BY THE HAYDEN-CARTWRIGHT ACT

The Hayden-Cartwright Act of June 18, 1934, altered the procedure for the public-works highway construction administered by the Bureau in some respects, and, in providing funds for the resumption of the policy of Federal aid in 1936 and 1937, made certain changes in policy as a result of the changed conditions of the last few years.

The importance of increased provision for secondary roads and of employment in rural areas was recognized by a requirement that not less than 25 percent of the funds provided by the act for the year 1935 should be expended on secondary roads. In the preceding year it had been required that not more than 25 percent should be expended on such roads.

To provide a program of projects for immediate construction, the rules and regulations issued by the Secretary of Agriculture with the approval of the Special Board for Public Works on July 7, 1934, required that initial programs be prepared by the several States consisting of approximately 25 percent of the apportionment under the Hayden-Cartwright Act, priority being given to projects in the following order: (1) The closing of gaps in the Federal-aid highway system; (2) the elimination of traffic hazards, particularly those caused by railroad grade crossings; (3) the improvement of those projects of particular use to other Government agencies; (4) road construction correlating and supplementing other existing transportation facilities; (5) the improvement of roadsides, involving not less than 1 percent of the total apportionment of each State; (6) reconstruction designed to reduce maintenance costs and decrease future expenditures; and (7) to provide a large number of small projects to employ the maximum of human labor. A substantial program of railroad grade-crossing elimination was required in each State.

Important changes were made in provisions applying to Federal aid to be resumed in the fiscal year 1936. Federal-aid funds have heretofore been limited in application to the Federal-aid system in rural and suburban areas and have not been available for use in the built-up portion of cities. With the initial improvement of the system nearing completion, the movement of traffic through cities has become an important problem, and the restriction on municipal improvements has been removed.

In many instances proper development of heavy-traffic routes on the Federal-aid system routes requiring wide, high-type, costly surfaces has been made difficult by the restriction of Federal participation to \$15,000 per mile. This restriction has been removed, and participation is possible up to 50 percent of the cost. This change will be particularly helpful where additional width is required and an amount close to \$15,000 has already been spent on the initial improvement.

In the last few years funds available to the States for road purposes have been considerably depleted by the diversion of motor-vehicle revenues and gasoline taxes to other purposes. The Hayden-Cartwright Act states the principle that it is unfair to tax highway transportation for purposes other than highway improvement and imposes on the Secretary of Agriculture the duty of withholding not more than one-third of Federal-aid apportionments to any State that applies to highway purposes a lesser amount of motor-vehicle fees and gasoline taxes than was legally required on June 18, 1934.

The occasional need of the States for funds with which to plan projects for future road construction and the generally recognized need for more complete information regarding the present condition of our complete highway system, the use being made of it, and the extent to which further improvements should be made led to the authorization that as much as 1½ percent of the \$200,000,000 provided for 1935 and of Federal-aid funds for the fiscal years 1936 and 1937 may be used for planning surveys.

At the close of the year, survey plans to give a clearer picture of our highway situation than has heretofore existed were being developed. The work is to be done in cooperation with the States and much of the data will be collected by white-collar workers taken from relief rolls.



## NATIONAL DEFENSE ROADS

A War Department study of highways, based on a previous collaboration of the Bureau with the War Department General Staff, established national defense highway priorities of improvement that will hereafter be considered by the Bureau in approving road programs involving the use of Federal funds. Some of the War Department recommendations with respect to these highways were as follows: (1) That certain roads selected by the War Department be at least two lanes wide with a minimum overhead clearance of 14 feet at all structures; (2) that bridges on major priority roads be designed for at least an H-15 loading as specified by the American Association of State Highway Officials and on minor priority roads for an H-10 loading as specified by the association;<sup>1</sup> and (3) that road surfaces be suitable to serve traffic comparable to that for which the bridges were designed under all weather conditions.

## THE EMERGENCY RELIEF APPROPRIATION ACT OF 1935

The Emergency Relief Appropriation Act of April 8, 1935, authorized the allocation of not to exceed \$800,000,000 for highways, roads, streets, and grade-crossing elimination. Under this authorization \$200,000,000 was allocated for highways, \$200,000,000 for grade-crossing work and \$100,000,000 was provided as the unappropriated balance of the \$200,000,000 authorized by the Hayden-Cartwright Act.

The funds for highways and grade crossings were apportioned by the Secretary of Agriculture on June 3, 1935; those for highways on the basis provided in the National Recovery Act; and, those for grade crossings one-fourth in proportion to mileage of the Federal-aid system, one-fourth in proportion to mileage of railroads, and one-half in proportion to population.

A great many grade crossings have been eliminated in past years with funds administered by the Bureau. However, the amount of work done has been far below the need. For the first time a major attack on this problem was possible.

As the year closed, rules and regulations for the expenditure of both funds were being prepared. These regulations contemplated wide diffusion of the funds, the requirement of a man-year of employment for each \$1,400 of highway funds expended, and the fixing of minimum wage limits by the States with the approval of the Department.

## HIGHWAY SAFETY

The increasing number of highway accidents is a matter of grave concern to all in positions of responsibility for highway construction or the use of highways. The Bureau has contributed to the solution of this problem by activity in several directions. In approval of plans for highway construction it has constantly endeavored to effect a desirable widening of surfaces, straightening of alignment and reduction of grades to make the roads suitable for the increased speed of modern traffic. The desirability of eliminating dangerous grade crossings, of adequate road marking, and of provision of footpaths and walks for pedestrians has also been strongly urged upon the States.

A manual for signs and markers has been prepared by the Bureau in cooperation with the American Association of State Highway Officials and other agencies and is now used as a standard throughout the country. Participating in the work of the National Conference on Street and Highway Safety, it has contributed to the preparation of, and has published, five codes relating to motor-vehicle registration and regulation proposed for uniform adoption by the States. Uniformity in regulation of motor vehicles must be one of the most important steps in promoting highway safety.

Special safety studies have been made in Rhode Island, South Carolina, and four cities of Tennessee in cooperation with local authorities and the Federal Emergency Relief Administration.

## STATUS OF MAJOR APPROPRIATIONS

Appropriations of several general types supported the greater part of the Bureau's work during the year. The major types were as follows:

(1) Federal-aid appropriations made under authorizations for fiscal years up to 1933. These appropriations must be matched with State or other funds, and

<sup>1</sup> The H-15 loading or heavier loading is used by practically all of the State highway departments in the design of bridges for primary roads. The H-10 loading is used in designing bridges for secondary roads.



when so matched are available for expenditure only on the approved Federal-aid highway system. These funds represented only a small portion of the year's program, and all such funds were obligated at the end of the fiscal year.

(2) Emergency relief funds appropriated by the act of 1932. These funds were available to the States to be used, in lieu of State funds, for the purpose of matching Federal-aid appropriations. They could also be used in conjunction with National Recovery funds.

(3) The appropriation made by section 204 of the National Industrial Recovery Act for the improvement of the Federal-aid system and its municipal extensions and secondary or feeder roads. This money was available for payment of the entire cost of improvements except expenses for right-of-way, and could be used in conjunction with Federal-aid funds or emergency-construction funds or both.

(4) The appropriation made by the Hayden-Cartwright Act providing for the emergency construction of public highways and related projects in accordance with the provisions of section 204 of the National Recovery Act as amended. The same act set up a fund of \$10,000,000 to be used in the repair of roads and bridges on the Federal-aid system damaged by floods, hurricanes, earthquakes, and landslides.

(5) The appropriation made by the Emergency Relief Appropriation Act of 1935 became available at the end of the year, but did not affect construction during the year.

Other appropriations more limited in scope and application were made for forest-highway construction and road building on Federal public lands.

#### FEDERAL-AID FUNDS

No Federal-aid funds were authorized for the fiscal year 1935. In the 3 years from 1931 to 1933, inclusive, they were authorized at the rate of \$125,000,000 a year, but the last authorization was subject to reduction in the amount of one-fifth of the amount actually expended of the emergency funds provided by the act of December 20, 1930. The amount so deducted was \$15,840,743.86. The Hayden-Cartwright Act provides that no further deductions are to be made as reimbursement for emergency advances of 1930 and 1932.

Table 3 gives for the fiscal years 1923 to 1933, inclusive, the amounts of the Federal-aid funds apportioned among the States after deducting the percentage allowable for Federal administration, and, for the same period of years with addition of 1934 and 1935, the amounts obligated to definite projects and amounts paid for work done during each of the years. It will be observed that the maximum rate of obligation and expenditure of these funds was reached in the fiscal year 1931, with recession in later years as the unobligated and unexpended balances were reduced and other funds became available. As shown by this table, the amount of Federal-aid funds paid to the States in the fiscal year 1935 was \$12,657,267.

TABLE 3.—*Federal-aid funds apportioned to the States, obligated to projects, and paid to the States each fiscal year from 1923 to 1935, inclusive*

Fiscal year	Apportioned amount of appropriation authorized for the year	Amount of Federal-aid funds obligated during the year	Amount of Federal-aid funds paid to States during the year
1923.....	\$48,750,000.00	\$77,461,559	\$69,677,241.86
1924.....	63,375,000.00	89,866,864	79,217,397.90
1925.....	73,125,000.00	87,294,396	95,749,998.11
1926.....	73,125,000.00	79,608,897	87,754,534.57
1927.....	73,125,000.00	77,453,046	81,371,013.03
1928.....	73,125,000.00	88,922,185	80,802,232.55
1929.....	73,125,000.00	70,428,896	82,097,380.38
1930.....	73,125,000.00	102,498,084	75,880,862.84
1931.....	121,875,000.00	157,952,903	133,340,910.64
1932.....	121,875,000.00	83,793,787	127,367,119.74
1933.....	106,034,256.14	46,689,026	101,266,331.02
1934.....		12,847,071	42,291,936.73
1935.....		2,343,260	12,657,266.66
Total.....	900,659,256.14	977,159,974	1,069,474,226.03
Average.....	<sup>1</sup> 81,878,114.19	75,166,152	82,267,248.15

<sup>1</sup> Average for 11 years. No Federal-aid funds were authorized for the fiscal years 1934 and 1935.

Details of this expenditure are given by States in table 4, which also shows the status of the unexpended funds at the close of the fiscal year. All of the authorized funds were at that time obligated. There was an unpaid balance of \$4,158,667; but of this sum a portion was already earned by the completion of work for which it was allotted, and the unearned balance was only approximately \$2,147,000 at the end of the year.

TABLE 4.—*Federal aid paid to States during the fiscal year 1935, and unpaid and unearned balances of the total Federal-aid apportionment on June 30, 1935*

State	Paid to States	Unpaid balance	Unearned balance
Alabama.....	\$1,699,369.02	\$343,760.02	\$214,000
Arizona.....	52,330.41	7,453.63	-----
Arkansas.....	513,796.00	134,619.99	71,000
California.....	28,547.56	8,238.65	-----
Colorado.....	167,904.89	43,568.05	29,000
Connecticut.....	271,644.57	202,677.39	113,000
Delaware.....	5,270.48	-----	-----
Florida.....	330,051.51	64,285.79	20,000
Georgia.....	118,649.70	65,808.87	63,000
Idaho.....	72,798.38	29,913.49	9,000
Illinois.....	627,295.10	238,107.83	71,000
Indiana.....	141,039.68	147,146.87	67,000
Iowa.....	-----	-----	-----
Kansas.....	113,490.85	-----	-----
Kentucky.....	25,173.97	17,329.69	8,000
Louisiana.....	124,285.64	127,068.51	113,000
Maine.....	172.41	-----	-----
Maryland.....	6,123.96	-----	-----
Massachusetts.....	325,243.77	43,859.64	10,000
Michigan.....	135,831.76	32,983.99	1,000
Minnesota.....	118,281.00	59,637.47	-----
Mississippi.....	1,595,857.68	491,873.71	353,000
Missouri.....	128,371.09	3,430.87	-----
Montana.....	414,085.51	49,839.01	25,000
Nebraska.....	151,237.92	-----	-----
Nevada.....	43,327.07	-----	-----
New Hampshire.....	44,660.77	1,781.13	1,000
New Jersey.....	693,237.16	119,884.33	-----
New Mexico.....	153,083.82	14,844.50	-----
New York.....	996,661.69	200,681.95	60,000
North Carolina.....	599,476.47	216,675.77	152,000
North Dakota.....	439,153.24	308,676.39	168,000
Ohio.....	117,103.84	135,253.23	71,000
Oklahoma.....	44,148.28	153,261.80	153,000
Oregon.....	251,107.17	33,236.17	2,000
Pennsylvania.....	54,240.81	104,907.39	1,000
Rhode Island.....	62,867.28	-----	-----
South Carolina.....	84,011.38	21,309.39	8,000
South Dakota.....	476,774.85	78,279.89	32,000
Tennessee.....	203,809.39	14,014.71	1,000
Texas.....	146,299.91	149,836.16	103,000
Utah.....	207,799.55	41,912.91	30,000
Vermont.....	6,553.48	-----	-----
Virginia.....	311,007.22	297,927.28	162,000
Washington.....	16,168.04	-----	-----
West Virginia.....	64,564.16	10,611.24	10,000
Wisconsin.....	63,232.16	3,257.98	-----
Wyoming.....	94,398.04	48,874.57	1,000
Hawaii.....	316,748.02	91,736.56	25,000
Total.....	12,657,266.66	4,158,666.82	2,147,000

By the Hayden-Cartwright Act, approved June 18, 1934, additional Federal-aid appropriations were authorized to be made in the amount of \$125,000,000 for each of the fiscal years 1936 and 1937. In accordance with the requirements of the Federal Highway Act, as amended, the first of these sums was apportioned on December 27, 1934, for construction work in the fiscal year 1936.

#### EMERGENCY-CONSTRUCTION FUNDS

The amount appropriated by the Emergency Relief and Construction Act of 1932 was \$120,000,000. The entire sum, without deduction for Federal administrative purposes, was apportioned among the several States and Hawaii as shown by table 5. These sums have since been expended in conjunction with Federal-aid apportionments, State funds, and apportionments under the Recovery Act, the total expenditure to June 30, 1935, being \$119,936,769, as detailed in table 5. Of the total payments to that date, only \$2,135,663 was expended during the fiscal year 1935.



TABLE 5.—*Emergency-construction apportionment, and amounts paid to States for the fiscal year 1935, and the total paid to June 30, 1935*

State	Emergency-construction apportionment	Paid to States during fiscal year	Total paid to States
Alabama.....	\$2,558,229	\$98,747.12	\$2,558,229.00
Arizona.....	1,700,771		1,700,771.00
Arkansas.....	2,101,182	198,704.63	2,101,182.00
California.....	4,667,188		4,667,188.00
Colorado.....	2,258,613	6,147.07	2,258,613.00
Connecticut.....	778,806		778,806.00
Delaware.....	600,000		600,000.00
Florida.....	1,624,752	18,259.64	1,624,752.00
Georgia.....	3,123,298		3,123,298.00
Idaho.....	1,505,912	42,339.53	1,505,912.00
Illinois.....	5,082,847		5,047,271.14
Indiana.....	3,058,980		3,058,980.00
Iowa.....	3,171,504		3,171,504.00
Kansas.....	3,265,048		3,265,048.00
Kentucky.....	2,264,637		2,264,637.00
Louisiana.....	1,745,559		1,745,569.00
Maine.....	1,067,079		1,067,079.00
Maryland.....	1,019,570	7,311.84	1,019,570.00
Massachusetts.....	1,716,612		1,716,612.00
Michigan.....	3,779,706	37,947.53	3,779,706.00
Minnesota.....	3,368,559		3,368,559.00
Mississippi.....	2,160,164	49,886.79	2,160,164.00
Missouri.....	3,753,453		3,753,453.00
Montana.....	2,525,071	.01	2,525,071.00
Nebraska.....	2,544,773		2,544,773.00
Nevada.....	1,575,756		1,575,756.00
New Hampshire.....	600,000	14,229.09	600,000.00
New Jersey.....	1,657,733	531,233.35	1,657,733.00
New Mexico.....	1,965,473		1,965,473.00
New York.....	6,059,238	128,014.47	6,031,583.32
North Carolina.....	2,888,251	37,559.60	2,888,251.00
North Dakota.....	1,933,901	153.55	1,933,901.00
Ohio.....	4,490,175	129,793.34	4,490,175.00
Oklahoma.....	2,888,723	26,047.13	2,888,723.00
Oregon.....	2,001,740	107,479.19	2,001,740.00
Pennsylvania.....	5,267,060		5,267,060.00
Rhode Island.....	600,000		600,000.00
South Carolina.....	1,666,755	88,473.71	1,666,755.00
South Dakota.....	2,004,573	57,283.61	2,004,573.00
Tennessee.....	2,605,160	54,721.42	2,605,160.00
Texas.....	7,664,621		7,664,621.00
Utah.....	1,395,331	126,374.98	1,395,331.00
Vermont.....	600,000		600,000.00
Virginia.....	2,256,178	308,467.62	2,256,178.00
Washington.....	1,920,470		1,920,470.00
West Virginia.....	1,323,912	54,523.46	1,323,912.00
Wisconsin.....	2,991,076	4,371.82	2,991,076.00
Wyoming.....	1,541,561		1,541,561.00
Hawaii.....	600,000	7,592.68	600,000.00
Total.....	120,000,000	2,135,662.88	119,936,769.46

## PUBLIC WORKS HIGHWAY FUNDS

The public works highway program was initiated by the National Industrial Recovery Act of June 16, 1933 under which the President allocated \$400,000,000 for highways. It was provided that work be done in accordance with the Federal Highway Act with the exception that extensions of the Federal-aid system into and through cities, and secondary roads, formerly ineligible for improvement, were included in the program.

Construction work financed with these funds had reached a peak at the close of the last fiscal year, with the prospect that a large part of the program would be completed and employment correspondingly decline during the fall months of 1934. In anticipation of the depletion of National Recovery funds, the Hayden-Cartwright Act of June 18, 1934, authorized an additional \$200,000,000 to be expended under the same general plan. Rules and regulations applying to new projects under both of the above-mentioned funds were issued on July 13, 1934. The new regulations differed from those formerly used where the experience of the previous year showed changes to be desirable, but the changes were not such as to alter the general character of the program. The most significant change, required



by the act, and applying only to the new funds, was that not less than 25 percent of the funds should be applied to secondary roads, whereas not more than 25 percent of the first authorization could be applied to roads of that class.

State programs showing types and locations of proposed improvements grouped according to the three classes of improvements contemplated—Federal-aid system, extensions of the system into and through municipalities, and secondary roads—were submitted and approved without undue delay. The apportionment of funds and assignments to classes of projects are shown in table 6.

TABLE 6.—*Apportionment and assignment of 1935 Public Works highway funds, June 30, 1935, as provided by the act of June 18, 1934*

State	Apportionment	Assignment of apportioned funds—					
		To projects on the Federal-aid system outside of municipalities		To projects on extensions of the Federal-aid system into and through municipalities		To projects on secondary or feeder roads	
	<i>Dollars</i>	<i>Dollars</i>	<i>Per cent</i>	<i>Dollars</i>	<i>Per cent</i>	<i>Dollars</i>	<i>Per cent</i>
Alabama.....	4,259,842	2,129,921.00	50.0	1,064,960.50	25.0	1,064,960.50	25.0
Arizona.....	2,641,935	1,338,712.23	50.7	305,191.25	11.5	998,031.52	37.8
Arkansas.....	3,428,049	1,714,000.00	50.0	857,025.00	25.0	857,024.00	25.0
California.....	7,932,206	3,713,643.00	46.9	2,219,360.00	27.9	1,999,203.00	25.2
Colorado.....	3,486,006	2,424,504.00	69.6	190,000.00	5.4	871,502.00	25.0
Connecticut.....	1,454,868	607,500.00	41.8	426,500.00	29.3	420,868.00	28.9
Delaware.....	923,395	461,697.50	50.0	230,848.75	25.0	230,848.75	25.0
Florida.....	2,661,343	1,116,600.00	42.0	501,200.00	18.8	1,043,543.00	39.2
Georgia.....	5,113,491	2,556,745.00	50.0	1,278,373.00	25.0	1,278,373.00	25.0
Idaho.....	2,277,486	1,131,910.00	49.7	321,126.00	14.1	824,450.00	36.2
Illinois.....	8,921,401	2,408,778.00	27.0	2,230,350.00	25.0	4,282,273.00	48.0
Indiana.....	5,088,963	2,816,686.80	55.3	2,136,306.41	42.0	135,969.79	2.7
Iowa.....	5,118,361	2,217,361.00	43.3	1,311,000.00	25.6	1,590,000.00	31.1
Kansas.....	5,117,675	2,354,130.50	46.0	1,432,949.00	28.0	1,330,595.50	26.0
Kentucky.....	3,818,311	1,302,208.76	34.1	958,598.85	25.1	1,557,503.39	40.8
Louisiana.....	2,963,932	1,380,419.00	46.6	744,560.00	25.1	838,953.00	28.3
Maine.....	1,711,586	782,195.00	45.7	484,379.00	28.3	445,012.00	26.0
Maryland.....	1,810,058	289,609.28	16.0	452,514.50	25.0	1,067,934.22	59.0
Massachusetts.....	3,350,474	1,582,874.00	47.2	847,600.00	25.3	920,000.00	27.5
Michigan.....	6,452,568	3,226,284.00	50.0	1,613,142.00	25.0	1,613,142.00	25.0
Minnesota.....	5,425,551	2,533,732.38	46.7	1,421,494.30	26.2	1,470,224.32	27.1
Mississippi.....	3,540,227	2,832,181.60	80.0	354,022.70	10.0	354,022.70	10.0
Missouri.....	6,173,740	2,890,666.00	46.8	919,152.29	14.9	2,363,921.71	38.3
Montana.....	3,769,734	2,714,208.00	72.0	113,092.00	3.0	942,434.00	25.0
Nebraska.....	3,964,364	1,982,182.00	50.0	991,091.00	25.0	991,091.00	25.0
Nevada.....	2,302,356	1,350,356.00	58.7	100,000.00	4.3	852,000.00	37.0
New Hampshire.....	969,462	465,404.39	48.0	242,464.77	25.0	261,592.84	27.0
New Jersey.....	3,220,879	951,379.00	29.6	1,809,500.00	56.0	460,000.00	14.4
New Mexico.....	2,941,700	1,676,769.00	57.0	529,506.00	18.0	735,425.00	25.0
New York.....	11,227,921	3,748,600.00	33.1	3,756,621.00	33.2	3,822,700.00	33.7
North Carolina.....	4,840,941	1,930,365.00	39.9	1,210,236.00	25.0	1,700,340.00	35.1
North Dakota.....	2,938,967	1,469,483.50	50.0	734,741.75	25.0	734,741.75	25.0
Ohio.....	7,865,012	3,539,255.40	45.0	2,359,503.60	30.0	1,966,253.00	25.0
Oklahoma.....	4,685,180	2,342,590.00	50.0	1,171,295.00	25.0	1,171,295.00	25.0
Oregon.....	3,097,814	1,452,741.00	46.9	867,977.00	28.0	777,096.00	25.1
Pennsylvania.....	9,590,788	4,554,082.00	47.5	2,397,703.00	25.0	2,639,003.00	27.5
Rhode Island.....	1,014,572	474,772.00	47.0	255,760.07	28.0	254,039.93	25.0
South Carolina.....	2,770,954	940,954.00	34.0	488,000.00	17.6	1,342,000.00	48.4
South Dakota.....	3,047,643	1,523,821.50	50.0	761,910.75	25.0	761,910.75	25.0
Tennessee.....	4,302,901	2,105,453.50	48.9	1,121,789.75	26.1	1,075,747.75	25.0
Texas.....	12,291,253	6,858,253.00	55.8	1,795,000.00	14.6	3,638,000.00	29.6
Utah.....	2,132,691	1,066,345.50	50.0	533,172.75	25.0	533,172.75	25.0
Vermont.....	948,007	466,042.22	49.2	240,610.51	25.4	241,354.27	25.4
Virginia.....	3,765,387	1,916,178.16	50.9	956,020.53	25.4	893,188.31	23.7
Washington.....	3,106,412	1,553,206.00	50.0	776,603.00	25.0	776,603.00	25.0
West Virginia.....	2,280,335	1,140,167.00	50.0	570,085.00	25.0	570,085.00	25.0
Wisconsin.....	4,941,837	1,818,970.00	36.8	1,379,513.00	27.9	1,743,354.00	35.3
Wyoming.....	2,287,712	1,686,368.00	73.7	29,416.00	1.3	571,928.00	25.0
District of Columbia.....	973,842	.....	.....	181,051.07	18.6	792,790.93	81.4
Hawaii.....	949,778	598,778.00	63.0	.....	.....	351,000.00	37.0
Total.....	200,000,000	94,139,083.22	47.1	47,703,317.10	23.8	58,157,599.68	29.1

Projects financed with the new funds were placed under construction in the fall months of 1934 and increased to a large volume with the opening of the 1935 construction season. On June 30, 1935, there remained only \$5,018,643 unobligated from 1934 funds and \$28,241,383 from 1935 funds, as shown by tables 7 and 8, and the amounts obligated were divided among the three classes of projects in the several States as shown.

TABLE 7.—*Status of obligation of apportioned 1934 Public Works highway funds, as provided by sec. 204 of the National Industrial Recovery Act, as of June 30, 1935*

State	Total apportionment	Obligated to projects—			Balance unobligated
		On the Federal-aid system outside of municipalities	On extensions of the Federal-aid system into and through municipalities	On secondary or feeder roads	
Alabama.....	\$8,370,133	\$3,938,300.93	\$2,366,921.07	\$1,989,824.33	\$75,086.67
Arizona.....	5,211,960	3,832,516.57	752,981.17	576,272.95	50,189.31
Arkansas.....	6,748,335	3,320,123.42	1,949,177.00	1,395,749.89	83,284.69
California.....	15,607,354	7,911,568.39	4,206,563.85	3,478,739.49	10,482.27
Colorado.....	6,874,530	3,437,265.00	1,691,030.53	1,718,632.00	27,602.47
Connecticut.....	2,865,740	1,403,217.56	802,407.00	659,120.00	995.44
Delaware.....	1,819,088	877,525.21	460,282.30	481,113.40	167.09
Florida.....	5,231,834	2,435,141.90	1,440,783.89	1,284,727.07	71,181.14
Georgia.....	10,091,185	4,906,398.58	2,508,673.57	2,225,582.09	450,530.76
Idaho.....	4,486,249	2,158,872.26	1,152,434.93	1,094,529.68	80,412.13
Illinois.....	17,570,770	4,398,271.90	7,372,059.36	5,772,761.93	27,676.81
Indiana.....	10,037,843	4,957,775.29	4,255,300.34	696,645.24	128,122.13
Iowa.....	10,055,660	5,027,830.00	2,614,433.23	2,412,650.83	745.94
Kansas.....	10,089,604	5,035,923.90	2,522,401.00	2,522,401.00	8,878.10
Kentucky.....	7,517,359	3,695,818.78	1,897,787.49	1,818,412.78	105,339.95
Louisiana.....	5,828,591	2,675,339.39	1,701,743.07	1,423,380.39	28,128.15
Maine.....	3,369,917	1,551,597.68	951,302.53	842,403.50	24,613.29
Maryland.....	3,564,527	1,685,373.73	646,473.56	891,102.08	331,577.63
Massachusetts.....	6,597,100	1,101,716.00	4,978,604.12	469,741.41	47,038.47
Michigan.....	12,736,227	5,997,341.23	3,481,531.06	3,148,167.22	109,187.49
Minnesota.....	10,656,569	4,478,513.42	3,663,878.72	2,344,284.06	169,892.80
Mississippi.....	6,978,675	3,421,063.27	1,671,170.59	1,709,381.43	177,029.71
Missouri.....	12,180,306	5,157,488.68	3,867,042.97	2,921,557.45	234,216.90
Montana.....	7,439,748	4,407,750.22	1,108,288.77	1,751,640.86	172,068.15
Nebraska.....	7,828,961	3,914,481.00	1,917,390.47	1,957,240.00	39,849.53
Nevada.....	4,545,917	2,905,727.57	473,901.01	1,134,166.80	32,121.62
New Hampshire.....	1,909,839	692,118.65	740,334.62	477,355.73	-----
New Jersey.....	6,346,039	3,138,919.21	3,010,962.24	55,098.73	141,058.82
New Mexico.....	5,792,935	2,846,648.00	1,595,456.19	1,272,129.00	78,701.81
New York.....	22,330,101	10,273,759.61	8,132,659.08	3,551,060.14	372,622.17
North Carolina.....	9,522,293	4,421,394.69	2,341,579.00	2,347,302.86	412,016.45
North Dakota.....	5,804,448	2,858,348.80	1,428,599.71	1,395,139.26	122,360.23
Ohio.....	15,484,592	7,269,116.38	4,331,665.58	3,804,002.44	79,807.60
Oklahoma.....	9,216,798	4,608,029.86	2,302,448.03	2,298,421.75	7,898.36
Oregon.....	6,106,896	3,023,562.66	1,491,183.47	1,520,866.38	71,283.49
Pennsylvania.....	18,891,004	6,634,762.26	4,789,914.06	7,326,867.91	139,459.77
Rhode Island.....	1,998,708	979,367.00	518,990.77	439,716.00	60,634.23
South Carolina.....	5,459,165	2,693,771.69	1,364,791.00	1,350,172.41	50,429.90
South Dakota.....	6,011,479	2,955,054.29	1,309,456.24	1,502,870.00	244,098.47
Tennessee.....	8,492,619	4,183,363.15	2,123,155.00	2,059,177.20	126,923.65
Texas.....	24,244,024	11,562,316.62	6,391,389.60	5,988,778.30	301,539.48
Utah.....	4,194,708	2,361,852.07	778,276.12	1,048,677.00	5,902.81
Vermont.....	1,867,573	921,854.08	487,129.24	438,631.41	19,958.27
Virginia.....	7,416,757	3,608,391.15	1,898,681.63	1,736,770.24	172,913.98
Washington.....	6,115,867	3,022,410.42	1,670,844.77	1,080,673.00	41,938.81
West Virginia.....	4,474,234	2,013,405.00	1,341,312.78	1,113,220.70	6,295.52
Wisconsin.....	9,724,881	4,691,114.92	2,572,507.70	2,416,978.30	44,280.08
Wyoming.....	4,501,327	2,246,419.91	1,118,858.53	1,122,741.51	13,307.05
District of Columbia.....	1,918,469	-----	946,444.55	972,024.45	-----
Hawaii.....	1,871,062	1,674,551.35	-----	177,717.69	18,792.96
Total.....	394,000,000	183,323,503.65	113,441,203.51	92,216,650.29	5,018,642.55

TABLE 8.—*Status of obligation of apportioned 1935 Public Works highway funds, as provided by the Hayden-Cartwright Act of June 18, 1934, as of June 30, 1935*

State	Total apportionment	Obligated to projects—			Balance unobligated
		On the Federal-aid system outside of municipalities	On extensions of the Federal-aid system into and through municipalities	On secondary or feeder roads	
Alabama.....	\$4, 259, 842	\$1, 730, 831. 76	\$515, 691. 15	\$922, 998. 22	\$1, 090, 320. 87
Arizona.....	2, 641, 935	1, 328, 956. 84	243, 308. 16	890, 907. 21	178, 762. 79
Arkansas.....	3, 428, 049	1, 447, 703. 32	597, 839. 24	705, 079. 59	677, 426. 85
California.....	7, 932, 206	3, 422, 068. 43	2, 107, 875. 95	1, 776, 642. 54	625, 619. 08
Colorado.....	3, 486, 006	2, 415, 213. 35	169, 410. 60	871, 502. 00	29, 880. 05
Connecticut.....	1, 454, 868	554, 725. 61	286, 496. 07	235, 769. 00	377, 877. 32
Delaware.....	923, 395	458, 528. 48	91, 830. 00	225, 543. 76	147, 492. 76
Florida.....	2, 661, 343	1, 085, 224. 72	257, 076. 78	1, 007, 468. 24	311, 573. 26
Georgia.....	5, 113, 491	1, 814, 344. 77	584, 658. 11	501, 535. 86	2, 212, 952. 26
Idaho.....	2, 277, 486	882, 877. 19	216, 565. 94	645, 405. 70	532, 637. 17
Illinois.....	8, 921, 401	2, 408, 778. 00	1, 629, 851. 62	3, 999, 583. 61	883, 187. 77
Indiana.....	5, 088, 963	2, 698, 122. 90	1, 845, 332. 95	109, 126. 18	436, 380. 97
Iowa.....	5, 118, 361	2, 086, 648. 60	1, 025, 235. 00	1, 589, 875. 00	416, 602. 40
Kansas.....	5, 117, 675	2, 354, 130. 50	1, 432, 949. 00	1, 330, 595. 50	-----
Kentucky.....	3, 818, 311	1, 223, 831. 01	678, 496. 75	1, 516, 907. 79	399, 075. 45
Louisiana.....	2, 963, 932	1, 140, 713. 29	607, 523. 18	820, 647. 53	395, 048. 00
Maine.....	1, 711, 586	780, 542. 75	477, 471. 72	437, 259. 15	16, 312. 38
Maryland.....	1, 810, 058	253, 219. 97	-----	595, 765. 90	961, 072. 13
Massachusetts.....	3, 350, 474	995, 238. 97	268, 282. 56	530, 432. 80	1, 556, 519. 67
Michigan.....	6, 452, 568	3, 011, 161. 48	1, 516, 000. 00	1, 613, 142. 00	312, 264. 52
Minnesota.....	5, 425, 551	2, 387, 270. 15	738, 320. 07	1, 380, 456. 60	919, 504. 18
Mississippi.....	3, 540, 227	2, 498, 515. 11	233, 200. 36	205, 413. 11	603, 098. 42
Missouri.....	6, 173, 740	2, 890, 666. 00	919, 152. 29	2, 363, 921. 71	-----
Montana.....	3, 769, 394	2, 671, 621. 92	72, 142. 80	886, 999. 42	138, 969. 86
Nebraska.....	3, 964, 364	1, 926, 812. 54	852, 565. 53	924, 940. 64	260, 045. 29
Nevada.....	2, 302, 356	1, 338, 009. 12	57, 842. 23	597, 352. 06	309, 152. 59
New Hampshire.....	969, 462	441, 404. 39	232, 399. 42	249, 411. 61	46, 246. 58
New Jersey.....	3, 220, 879	600, 774. 15	749, 388. 92	107, 524. 70	1, 763, 191. 23
New Mexico.....	2, 941, 700	1, 676, 769. 00	249, 529. 20	719, 271. 01	296, 130. 79
New York.....	11, 327, 921	3, 503, 681. 69	3, 410, 690. 00	3, 612, 338. 61	801, 210. 70
North Carolina.....	4, 840, 941	1, 305, 283. 86	1, 143, 691. 89	1, 545, 690. 96	846, 274. 29
North Dakota.....	2, 938, 967	885, 776. 14	336, 445. 99	284, 816. 64	1, 431, 928. 23
Ohio.....	7, 865, 012	2, 946, 033. 00	1, 888, 317. 24	1, 519, 992. 91	1, 510, 668. 85
Oklahoma.....	4, 685, 180	2, 179, 830. 87	901, 915. 89	396, 412. 65	607, 020. 59
Oregon.....	3, 097, 814	1, 383, 798. 86	775, 726. 37	777, 066. 00	161, 192. 77
Pennsylvania.....	9, 590, 788	4, 357, 459. 16	1, 766, 369. 87	2, 501, 400. 28	965, 558. 69
Rhode Island.....	1, 014, 572	464, 572. 00	141, 760. 07	249, 377. 60	158, 862. 33
South Carolina.....	2, 770, 954	490, 600. 50	275, 166. 84	1, 275, 504. 85	729, 681. 81
South Dakota.....	3, 047, 643	1, 399, 995. 31	265, 267. 12	595, 542. 98	786, 837. 59
Tennessee.....	4, 302, 991	2, 059, 254. 78	860, 348. 46	799, 753. 66	583, 634. 10
Texas.....	12, 291, 253	6, 205, 849. 09	1, 358, 195. 53	3, 550, 602. 77	1, 176, 605. 61
Utah.....	2, 132, 691	929, 074. 55	530, 866. 11	532, 172. 75	140, 577. 97
Vermont.....	948, 007	456, 585. 01	213, 220. 57	240, 451. 45	37, 749. 99
Virginia.....	3, 765, 387	1, 760, 241. 51	871, 627. 68	844, 613. 05	288, 904. 76
Washington.....	3, 106, 412	1, 543, 022. 85	755, 870. 96	775, 338. 42	32, 179. 77
West Virginia.....	2, 280, 335	771, 614. 92	258, 676. 10	394, 680. 80	855, 363. 18
Wisconsin.....	4, 941, 837	1, 775, 710. 73	1, 356, 431. 36	1, 623, 472. 57	186, 222. 34
Wyoming.....	2, 287, 712	1, 641, 416. 00	16, 916. 00	550, 850. 91	78, 529. 09
District of Columbia.....	973, 842	-----	181, 051. 07	504, 116. 38	288, 674. 55
Hawaii.....	949, 778	273, 416. 37	-----	-----	676, 361. 63
Total.....	200, 000, 000	84, 857, 921. 52	35, 964, 990. 72	50, 935, 704. 68	28, 241, 383. 08

The amounts paid to the several States for work done under the National Industrial Recovery Act, described as 1934 funds, and the Hayden-Cartwright Act, described as 1935 funds, are given in table 9. These amounts do not include \$14,175,000 from 1934 funds and \$20,625,000 from 1935 funds, as shown in the footnote of table 9, advanced to the States to provide revolving funds for direct payment of sums due for work done, nor do they include amounts due for work completed in a number of States for which, at the time, the Federal Government had not made reimbursement.



TABLE 9.—*Amounts paid to the States from 1934 and 1935 Public Works highway funds provided by section 204 of the National Industrial Recovery Act, and the Hayden-Cartwright Act of June 18, 1934, to June 30, 1935*

State	1934 funds	1935 funds	State	1934 funds	1935 funds
Alabama.....	\$6,931,469.53	\$835,720.72	New Hampshire.....	\$1,808,364.34	\$381,547.18
Arizona.....	4,831,774.08	912,237.23	New Jersey.....	5,321,260.24	129,813.52
Arkansas.....	5,557,843.03	844,391.60	New Mexico.....	4,546,657.67	1,321,203.11
California.....	13,715,032.65	638,263.03	New York.....	18,795,868.35	1,933,724.70
Colorado.....	6,483,968.20	1,935,406.48	North Carolina.....	7,569,167.89	947,345.32
Connecticut.....	2,412,116.87	357,230.33	North Dakota.....	4,306,854.86	235,846.43
Delaware.....	1,549,273.59	78,094.86	Ohio.....	14,555,886.80	1,075,254.00
Florida.....	4,774,483.91	912,777.98	Oklahoma.....	8,456,248.22	1,100,214.08
Georgia.....	7,824,108.54	810,934.67	Oregon.....	5,458,824.91	805,017.90
Idaho.....	4,126,093.70	489,359.24	Pennsylvania.....	15,858,935.45	2,586,088.58
Illinois.....	14,168,547.33	512,272.10	Rhode Island.....	1,775,611.06	296,332.19
Indiana.....	7,678,680.96	38,151.79	South Carolina.....	4,565,689.32	561,873.18
Iowa.....	9,464,102.79	1,440,225.34	South Dakota.....	4,502,596.75	251,468.78
Kansas.....	9,692,323.21	2,392,902.52	Tennessee.....	7,727,350.30	1,059,711.02
Kentucky.....	6,801,132.78	882,102.80	Texas.....	21,882,778.95	3,147,197.55
Louisiana.....	4,808,383.01	579,200.15	Utah.....	3,885,833.03	895,456.15
Maine.....	3,136,300.29	525,423.09	Vermont.....	1,638,755.71	297,273.37
Maryland.....	2,354,529.23	262,696.74	Virginia.....	5,674,659.43	726,456.41
Massachusetts.....	4,927,132.55	251,815.34	Washington.....	5,783,888.60	868,995.57
Michigan.....	11,569,048.96	1,161,863.97	West Virginia.....	3,631,441.91	289,320.30
Minnesota.....	8,749,859.02	2,008,743.42	Wisconsin.....	8,921,109.86	863,458.84
Mississippi.....	4,974,648.28	718,245.61	Wyoming.....	4,166,034.05	562,419.00
Missouri.....	10,593,796.41	1,257,797.79	District of Columbia.....	1,820,067.07	492,386.79
Montana.....	6,744,092.72	1,505,492.18	Hawaii.....	1,551,816.84	-----
Nebraska.....	6,554,222.94	1,343,639.60			
Nevada.....	4,118,805.97	867,979.25			
			Total <sup>1</sup> .....	338,837,772.16	44,791,371.83

<sup>1</sup> In addition \$14,175,000 of 1934 funds and \$20,625,000 of 1935 funds had been advanced to 33 States, the District of Columbia, and Hawaii to provide revolving funds from which payments were made directly.

### PROGRESS OF FEDERAL-AID ROAD CONSTRUCTION

During the fiscal year a considerable mileage of road built under the Federal-aid plan was brought to completion, in spite of the diminished amount of such funds. At the close of the year Federal-aid funds for all prior years had been absorbed by assignment to projects in the current program. In doing this, advantage was taken by the States of the provision that Public Works highway grants could be used in lieu of State funds to match Federal-aid money.

Initial Federal-aid improvements were completed during the fiscal year on 1,866 miles of the Federal-aid highway system; advanced stages of improvement were constructed on 803 miles; and 12 miles previously improved were reconstructed. The total Federal-aid construction completed was therefore 2,681 miles. The result of the year's work in this single class of activity was much less than the similar mileage improved during the preceding year, which was 14,780 miles.

The improvements classed as completed and included in the above mileage figures were not only physically completed but have also been paid for by the Federal Government to the full extent of its obligation.

The distribution of the completed mileage by States, its total cost, and the Federal-aid involved are shown in table 10. For the country as a whole, the total cost was \$68,651,782, of which \$26,720,304 was paid from Federal-aid funds and the balance from Federal emergency and State funds. Table 11 shows the types of road comprising this improvement.

TABLE 10.—*Total cost, Federal aid, and mileage of Federal-aid roads, initial and stage construction, and reconstruction completed and paid for during the fiscal year 1935*<sup>1</sup>

State	Total cost	Federal aid	Mileage		
			Initial	Stage	Total
Alabama.....	\$2,501,895.01	\$1,238,792.53	38.1	79.0	117.1
Arizona.....	218,613.80	173,488.57	.5	8.7	9.2
Arkansas.....	1,316,840.86	586,614.36	91.4	35.0	126.4
California.....	2,029,733.83	452,616.12	25.2	3.4	28.6
Colorado.....	1,209,249.51	561,459.27	50.5	12.0	62.5
Connecticut.....	1,980,469.05	865,310.68	13.3	.....	13.3
Delaware.....	123,577.77	27,824.92	.....	7.2	7.2
Florida.....	2,396,864.34	1,075,939.48	51.1	4.0	55.1
Georgia.....	819,325.22	279,859.48	31.5	19.0	50.5
Idaho.....	553,134.07	226,731.05	10.9	47.4	58.3
Illinois.....	9,174,102.41	3,789,801.21	232.3	23.5	255.8
Indiana.....	3,746,149.04	1,581,502.34	68.5	.....	68.5
Kentucky.....	412,112.68	166,211.38	7.1	16.4	23.5
Louisiana.....	1,949,408.46	904,703.29	7.7	.....	7.7
Maryland.....	172,238.75	20,284.20	2.4	.....	2.4
Massachusetts.....	3,366,646.11	728,047.15	45.9	4.9	50.8
Michigan.....	2,359,732.36	871,600.87	76.6	32.1	108.7
Minnesota.....	1,503,853.54	504,332.38	9.3	53.3	62.6
Mississippi.....	4,653,854.55	2,296,409.81	137.2	93.6	230.8
Missouri.....	307,799.33	73,274.28	.9	2.4	3.3
Montana.....	1,490,369.66	832,357.27	84.3	75.4	159.7
New Hampshire.....	204,887.10	85,805.63	2.4	2.3	4.7
New Jersey.....	2,938,442.43	837,835.57	27.7	.....	27.7
New Mexico.....	47,997.80	23,998.90	.2	.....	.2
New York.....	5,566,088.20	1,868,735.38	151.9	.8	152.7
North Carolina.....	428,302.64	207,649.10	29.6	.....	29.6
North Dakota.....	142,333.37	52,383.69	22.2	37.7	59.9
Ohio.....	1,274,885.93	224,741.83	8.7	.....	8.7
Oklahoma.....	788,387.58	372,244.77	45.5	.....	45.5
Oregon.....	642,222.63	273,907.41	14.3	18.4	32.7
Pennsylvania.....	2,005,135.52	531,609.42	63.3	.....	63.3
South Carolina.....	1,698,519.43	616,146.04	97.5	65.9	163.4
South Dakota.....	501,452.16	256,386.80	71.8	25.4	97.2
Tennessee.....	1,180,685.45	556,567.38	24.8	<sup>2</sup> 19.4	44.2
Texas.....	1,913,020.87	775,025.61	66.3	36.3	102.6
Utah.....	1,140,334.99	456,292.74	43.6	56.7	100.3
Vermont.....	40,373.04	2,715.08	1.8	.....	1.8
Virginia.....	2,677,316.51	1,035,989.54	128.4	22.3	150.7
Washington.....	475,176.37	84,810.39	5.4	.....	5.4
West Virginia.....	1,406,555.76	441,312.94	41.9	.....	41.9
Wisconsin.....	53,529.72	4,000.00	1.3	.....	1.3
Wyoming.....	135,151.72	64,000.00	6.2	12.8	19.0
Hawaii.....	1,105,012.92	690,985.60	26.7	.....	26.7
Total.....	68,651,782.49	26,720,304.46	1,866.2	<sup>2</sup> 815.3	2,681.5

<sup>1</sup> No projects completed and paid for during the fiscal year in States not listed.<sup>2</sup> Includes 11.6 miles of reconstruction.

A few projects which had been completed were not classified as completed as the final payment by the Federal Government had not been made. In this report these projects are classified with those under construction and approved for construction at the close of the year. Altogether, the projects in these three stages, representing the active Federal-aid improvement program at the end of the year, involved only 255 miles, as compared with a total of 2,921 miles the previous year. The large decrease is the result of the complete exhaustion of available Federal-aid funds.

Of the total of 255 miles in the current program at the end of the year, 190 miles were in course of initial improvement and 65 miles were in course of stage construction, active or planned.

TABLE 11.—Mileage of Federal-aid roads, by types of construction, completed and final payment made during the fiscal year 1935<sup>1</sup>

State	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Totals		
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							Initial	Stage	Total
Alabama.....													38.1	79.0	117.1
Arizona.....	14.6						27.5		14.7	57.8		0.8	1.1	8.7	9.2
Arkansas.....	4						62.8			6.0		1.0	91.4	35.0	126.4
California.....	18.6		29.7	8.3					5.3				25.2	3.4	28.6
Colorado.....	13.5		53.3				8.2					1.0	50.5	12.0	62.5
Connecticut.....	4							0.6	.2	9.2		2.9	13.3		13.3
Delaware.....	7.2													7.2	7.2
Florida.....	35.0									18.4		1.7	51.1	19.0	55.1
Georgia.....	24.8									25.6		1.1	31.5	47.4	58.3
Idaho.....			16.3				42.0			234.2		3.5	232.3	23.5	253.8
Illinois.....	18.1								7.7			4.6	68.5		68.5
Indiana.....	8.4									16.4		1.1	7.1	16.4	23.5
Iowa.....	7.0											1.3	7.7		7.7
Kentucky.....	5.3		1.1										2.4		2.4
Louisiana.....										2.3		1.7	45.9	4.9	50.8
Maryland.....								23.6		17.0		1.7	76.6	32.1	108.7
Massachusetts.....	2.6		26.0						10.5	69.1		1.5	9.3	53.3	62.6
Michigan.....										62.5			137.2	93.6	230.8
Minnesota.....	112.6		4.4						19.3	81.7		3.5	5.9	2.4	3.3
Mississippi.....		9.3	2.8										84.3	75.4	159.7
Missouri.....			17.9							4.0			27.7	2.3	4.7
Montana.....	29.8						111.6			19.3			151.9		27.7
New Hampshire.....					.7				3.4	78.4			22.2		29.6
New Jersey.....	8.0							20.4					87.7	37.7	59.9
New Mexico.....													45.5		45.5
New York.....	12.3		37.3		8.5				3.6	3.8	0.7		14.3	18.4	32.7
North Carolina.....	21.1		24.3						15.8	16.9			63.3		63.3
North Dakota.....	34.9								8.8	25.1			97.5	55.9	163.4
Ohio.....	20.1									17.5			71.8	25.4	97.2
Oklahoma.....				12.1									24.8	19.4	44.2
Oregon.....						29.1							66.3	36.3	102.6
Pennsylvania.....	20.9	111.8					25.4		5.2	15.3		1.1	66.3	56.7	100.3
South Carolina.....	39.4		32.3							2.4		2.4	43.9		46.3
South Dakota.....	22.6												128.4	22.3	150.7
Tennessee.....	57.1						85.1		1.6	19.5			3.4		5.4
Texas.....			6.0	11.5									41.9	1.3	41.9
Utah.....			11.9		44.9	5.4							6.2		6.2
Vermont.....			1.6										26.7		26.7
Virginia.....	66.6		2.0												
Washington.....	9.8														
West Virginia.....	5.4														
Wisconsin.....	29.2		3.0			5.1				1.3					
Wyoming.....	6.2														
Hawaii.....															
Total.....	552.3	101.3	291.0	51.2	82.5	12.9	384.8	71.1	104.6	884.3	.7	33.0	1,866.2	815.3	2,681.5

<sup>1</sup> No mileage completed and final payment made during the fiscal year in States not listed.



The distribution, by States, of the Federal-aid mileage in the three stages of progress toward completion is shown in table 12, together with estimated total costs and the amounts of Federal aid allotted. As in the case of the completed projects the difference between the total cost and the Federal aid has been supplied from Federal emergency-construction funds and State funds. For the country as a whole, the estimated cost of the projects in progress toward completion at the end of the year was \$7,126,347; the Federal aid allotted was \$2,902,276.

The classification of the projects in the active program by types of surface improvement is shown in table 13.

TABLE 12.—*Total cost, Federal aid, and mileage of Federal-aid roads, initial and stage improvement, finally inspected, under construction, and approved for construction, June 30, 1935*<sup>1</sup>

State	Estimated total cost	Federal aid allotted <sup>2</sup>	Mileage		
			Initial	Stage	Total
Florida.....	\$60,870.23	\$30,435.11	6.6	-----	6.6
Idaho.....	285,791.82	100,207.19	11.2	2.5	13.7
Illinois.....	844,052.38	295,835.53	12.0	20.6	32.6
Indiana.....	1,075,119.20	468,901.51	36.5	-----	36.5
Louisiana.....	526,881.94	256,601.57	-----	.4	.4
Michigan.....	84,600.00	37,000.48	.5	.3	.8
Minnesota.....	888,670.49	333,114.93	34.6	-----	34.6
Mississippi.....	174,457.73	87,228.86	-----	8.2	8.2
New York.....	1,083,919.43	304,629.71	35.7	-----	35.7
North Dakota.....	350,769.16	350,553.58	1.9	-----	1.9
Ohio.....	90,780.00	45,390.00	5.3	-----	5.3
Oklahoma.....	833,060.90	339,104.72	18.3	21.0	39.3
Pennsylvania.....	528,840.88	162,417.62	19.0	-----	19.0
Texas.....	298,532.44	90,855.62	8.3	11.7	20.0
Total.....	7,126,346.60	2,902,276.43	189.9	64.7	254.6

<sup>1</sup> No projects in this status in States not listed and Hawaii.

<sup>2</sup> Does not include Federal aid allotted to Public Works projects.

TABLE 13.—*Mileage of Federal-aid roads, by types of construction, initial and stage, finally inspected under construction and approved for construction, June 30, 1935*<sup>1</sup>

State	Graded and drained	Un-treated gravel	Un-treated macadam	Low cost bituminous mix	Bituminous concrete	Portland-cement concrete	Bridges and approaches	Total		
								Initial	Stage	Total
Florida.....	6.6	-----	-----	-----	-----	-----	-----	6.6	-----	6.6
Idaho.....	-----	11.1	-----	2.5	-----	-----	0.1	11.2	2.5	13.7
Illinois.....	-----	-----	-----	-----	-----	32.5	.1	12.0	20.6	32.6
Indiana.....	-----	-----	-----	-----	-----	36.5	-----	36.5	-----	36.5
Louisiana.....	-----	-----	-----	-----	-----	.2	.2	-----	.4	.4
Michigan.....	-----	-----	-----	-----	-----	.5	.3	.5	.3	.8
Minnesota.....	-----	-----	-----	-----	-----	34.6	-----	34.6	-----	34.6
Mississippi.....	.2	-----	-----	-----	-----	8.0	-----	-----	8.2	8.2
New York.....	5.8	20.7	-----	-----	-----	9.0	.2	35.7	-----	35.7
North Dakota.....	-----	1.6	-----	-----	-----	-----	.3	1.9	-----	1.9
Ohio.....	-----	-----	-----	-----	5.3	-----	-----	5.3	-----	5.3
Oklahoma.....	13.0	-----	-----	-----	-----	26.2	.1	18.3	21.0	39.3
Pennsylvania.....	-----	-----	7.9	-----	5.1	6.0	-----	19.0	-----	19.0
Texas.....	8.2	-----	-----	-----	-----	11.8	-----	8.3	11.7	20.0
Total.....	33.8	33.4	7.9	2.5	10.4	165.3	1.3	189.9	64.7	254.6

<sup>1</sup> No projects in this status in States not listed and Hawaii.

### PROGRESS IN PUBLIC WORKS HIGHWAY CONSTRUCTION

The Public Works highway program, initiated in June 1933 with \$400,000,000 provided by the National Recovery Act and supplemented in June 1934 with \$200,000,000 authorized by the Hayden-Cartwright Act has resulted in a completed mileage sufficient to encircle the earth, and at the close of the year the mileage included in the current program, either under construction or planned, exceeded the diameter of the earth.

From the beginning of construction in August 1933 up to the end of the fiscal year 1935, construction has been begun on 33,129 miles of road and completed on 24,600 miles, leaving 8,529 miles under construction on June 30, 1935. On the same date projects approved for construction included 1,427 miles, so that there was included in the 2 years' program a total of 34,556 miles.

The total cost of projects completed under the program has been \$397,355,775, of which \$335,830,226 was from 1934 Public Works highway funds, and \$30,071,390 was from 1935 similar funds. The estimated total cost of the projects under construction at the end of the year was \$185,049,282, of which \$50,310,307 was 1934 funds, and \$118,520,398 was 1935 funds. The projects approved for construction at the same time amounted to \$27,826,927, of which \$2,840,824 was from 1934 funds and \$23,166,829 from 1935 funds. The total for the 2-year active program, not including projects approved for construction, was \$582,405,057. The above total amounts include small amounts of Federal-aid funds and State funds.

Of the 24,600 miles of completed projects, 13,338 miles were located on the Federal-aid highway system outside of municipalities. This improvement cost \$201,669,124, of which \$178,805,890 was paid from Public Works funds, and the remainder from Federal-aid funds and from Federal emergency-construction and State funds.

On extensions of the Federal-aid system into and through municipalities there were completed 1,904 miles, costing \$103,763,295. Of the total cost of this mileage, the Public Works funds provided \$99,605,210, and the balance was provided from the above-mentioned sources.

The remaining completed mileage—9,358 miles, costing \$91,923,356—consisted of secondary or feeder roads. The cost of these was met to the extent of \$87,490,517 from Public Works funds and the balance was paid from State funds. Federal-aid and emergency-construction funds were not available for this portion of the work because the roads improved are in no case included in the Federal-aid system.

The distribution, by States, of the mileage completed to June 30, 1935, in each of the three classes of projects is given in tables 14 and 15, together with total costs of the roads built and the amounts of the funds used in each of the fiscal years 1934 and 1935.

Of the 8,530 miles under construction at the end of the year, 4,003 miles were on the Federal-aid system outside of municipalities, 509 miles on extensions of the system into and through cities, and 4,018 miles on secondary or feeder roads. The estimated costs of each of these groups of projects, the sources of the funds employed, and the distribution by States are shown in tables 16 and 17.

TABLE 14.—*Total cost and mileage of 1934 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act, completed to June 30, 1935, and Federal funds allotted thereto, by States*

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$6,205,589.83	\$3,370,573.59	\$2,827,592.07	326.0
Arizona.....	4,501,873.17	3,832,516.57	78,138.13	297.3
Arkansas.....	3,044,050.54	2,517,988.43	499,568.46	152.8
California.....	10,463,432.19	7,752,827.83	8,238.65	311.6
Colorado.....	3,458,657.71	3,347,940.85	87,057.48	156.7
Connecticut.....	794,425.68	791,923.12	-----	14.5
Delaware.....	875,222.73	868,470.17	-----	33.4
Florida.....	3,025,254.26	2,214,247.01	756,396.29	115.7
Georgia.....	4,158,574.97	3,921,287.59	65,840.00	285.3
Idaho.....	2,097,380.44	2,027,113.60	-----	173.1
Illinois.....	2,438,123.40	2,392,590.47	-----	39.3
Indiana.....	3,574,648.62	3,451,916.23	-----	112.9
Iowa.....	4,806,144.05	4,720,930.00	-----	259.1
Kansas.....	5,135,668.69	5,004,394.25	113,490.85	402.7
Kentucky.....	3,623,147.32	3,379,305.06	-----	244.5
Louisiana.....	2,664,382.38	2,295,364.99	-----	76.2
Maine.....	1,463,772.98	1,433,663.50	-----	44.0
Maryland.....	792,730.48	791,495.03	-----	14.8
Massachusetts.....	1,466,324.25	1,049,029.03	385,643.88	37.4

<sup>1</sup> No projects of this class completed in the District of Columbia.



TABLE 14.—Total cost and mileage of 1934 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act, completed to June 30, 1935, and Federal funds allotted thereto, by States—Con.

## PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES—Contd.

State	Total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Michigan.....	\$5,175,046.24	\$4,921,541.23	\$49,000.00	231.6
Minnesota.....	4,333,008.47	4,235,784.24	57,982.87	747.7
Mississippi.....	4,649,133.81	2,521,708.69	2,087,522.91	245.5
Missouri.....	4,883,071.14	4,295,899.47	100,748.60	198.1
Montana.....	4,872,999.11	4,403,620.91	373,577.49	377.7
Nebraska.....	5,004,657.89	3,888,841.49	248,543.24	356.5
Nevada.....	2,754,513.50	2,683,175.23	43,327.07	260.3
New Hampshire.....	638,683.78	612,389.01	.....	10.8
New Jersey.....	2,189,130.63	2,025,845.49	139,466.42	37.4
New Mexico.....	2,392,412.26	2,748,086.29	143,929.42	274.2
New York.....	11,245,771.06	9,011,287.80	461,500.00	219.5
North Carolina.....	4,274,856.34	3,580,995.46	680,062.84	557.8
North Dakota.....	3,005,644.11	2,611,832.03	370,075.02	961.5
Ohio.....	7,431,049.76	7,040,235.46	51,410.00	191.3
Oklahoma.....	4,337,923.71	4,201,026.95	6,235.56	297.9
Oregon.....	3,284,391.98	2,942,972.75	217,337.94	182.8
Pennsylvania.....	6,463,235.70	6,190,604.69	3,826.93	127.4
Rhode Island.....	968,004.74	899,627.39	62,867.28	20.5
South Carolina.....	2,424,177.24	2,359,621.33	62,876.51	208.2
South Dakota.....	2,920,377.33	2,451,549.34	458,415.98	485.6
Tennessee.....	4,645,729.84	4,004,620.87	593,951.35	180.9
Texas.....	11,770,771.03	11,174,335.63	.....	1,005.8
Utah.....	2,467,363.33	2,324,852.07	48,000.00	195.2
Vermont.....	951,975.39	911,183.87	.....	44.8
Virginia.....	3,666,117.71	3,322,846.03	235,430.47	146.1
Washington.....	2,855,483.04	2,794,488.77	3,356.82	162.7
West Virginia.....	1,943,070.51	1,901,842.01	12,956.18	72.1
Wisconsin.....	4,434,758.01	4,220,288.15	39,690.00	209.0
Wyoming.....	2,227,399.17	2,064,028.48	140,708.57	457.3
Hawaii.....	829,029.22	526,724.18	232,492.95	19.3
Total.....	184,029,189.74	162,035,432.63	11,747,258.23	11,522.8

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES<sup>2</sup>

Alabama.....	\$1,777,249.49	\$1,768,479.78	.....	43.9
Arizona.....	632,961.16	623,659.51	.....	13.2
Arkansas.....	1,699,989.32	1,599,133.99	\$95,457.30	42.5
California.....	4,459,926.89	3,849,724.09	.....	52.5
Colorado.....	1,768,937.14	1,675,081.08	.....	35.3
Connecticut.....	828,471.21	802,407.00	23,450.79	10.2
Delaware.....	468,789.18	460,282.30	.....	6.7
Florida.....	1,723,761.56	1,437,885.39	282,545.85	18.7
Georgia.....	2,232,507.32	2,200,119.62	.....	68.3
Idaho.....	1,149,665.60	1,107,063.23	.....	18.3
Illinois.....	6,418,737.15	6,122,745.55	.....	66.4
Indiana.....	3,174,027.17	3,034,021.12	.....	63.5
Iowa.....	2,098,436.48	2,013,667.98	.....	51.1
Kansas.....	2,554,892.04	2,401,598.40	.....	37.1
Kentucky.....	1,408,314.08	1,416,933.57	.....	32.4
Louisiana.....	748,870.30	744,920.59	.....	18.5
Maine.....	830,660.76	825,162.11	172.41	16.4
Maryland.....	390,020.65	384,016.57	.....	3.6
Massachusetts.....	2,143,777.41	2,102,232.49	37,100.00	13.4
Michigan.....	3,239,170.40	3,104,881.06	.....	39.0
Minnesota.....	3,189,479.97	3,140,755.80	2,500.00	98.3
Mississippi.....	911,532.05	897,960.23	12,459.50	28.7
Missouri.....	2,920,631.89	2,844,980.94	.....	51.7
Montana.....	1,025,022.12	1,012,209.09	939.47	34.0
Nebraska.....	1,951,800.54	1,917,390.47	.....	33.0
Nevada.....	479,799.69	473,901.01	.....	9.4
New Hampshire.....	672,133.04	668,775.82	1,484.17	15.6
New Jersey.....	2,952,932.93	2,828,272.05	103,846.83	22.5
New Mexico.....	1,471,683.93	1,471,119.76	.....	33.8
New York.....	7,588,170.47	7,168,742.06	39,000.00	58.0
North Carolina.....	2,128,779.90	2,125,249.40	1,701.23	75.0
North Dakota.....	1,078,034.52	1,070,768.53	586.33	45.8
Ohio.....	4,710,282.60	4,238,313.72	.....	59.5
Oklahoma.....	2,178,496.66	2,098,798.20	779.60	44.7
Oregon.....	1,470,358.96	1,424,030.60	13,625.38	27.7
Pennsylvania.....	4,362,458.61	4,197,457.50	.....	58.6

<sup>2</sup> No projects of this class completed in Hawaii.



TABLE 14.—Total cost and mileage of 1934 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act, completed to June 30, 1935, and Federal funds allotted thereto, by States—Con.

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Rhode Island.....	\$519,889.48	\$518,990.77		7.4
South Carolina.....	1,095,075.84	1,092,876.53	\$405.01	34.5
South Dakota.....	1,070,769.37	1,070,366.12		35.7
Tennessee.....	1,759,229.54	1,740,185.92		24.8
Texas.....	5,216,863.22	5,093,601.29		117.5
Utah.....	699,529.23	649,145.73		16.7
Vermont.....	529,077.38	460,327.69	6,553.48	13.7
Virginia.....	1,282,757.36	1,250,265.23	10,812.54	25.1
Washington.....	1,942,398.47	1,922,046.25		22.1
West Virginia.....	1,042,645.05	1,005,009.18		15.8
Wisconsin.....	2,477,252.65	2,401,817.98	25,898.24	51.6
Wyoming.....	974,383.29	971,191.34		22.3
District of Columbia.....	696,280.55	696,280.55		4.5
Total.....	98,216,914.62	94,124,775.19	659,318.13	1,750.0

PROJECTS ON SECONDARY OR FEEDER ROADS

Alabama.....	\$1,486,623.66	\$1,482,576.10		109.2
Arizona.....	549,547.58	531,272.95		43.8
Arkansas.....	1,249,714.14	1,243,181.47		149.1
California.....	3,592,883.65	2,684,134.18		164.3
Colorado.....	1,696,998.30	1,605,434.83		138.3
Connecticut.....	179,776.83	160,281.50		3.1
Delaware.....	269,715.25	265,665.61		14.1
Florida.....	1,297,524.39	1,284,727.07		74.8
Georgia.....	1,623,724.69	1,604,794.36		123.1
Idaho.....	1,263,231.37	1,094,529.68		144.3
Illinois.....	3,073,727.65	3,035,675.87		160.0
Indiana.....	425,393.70	386,212.34		44.1
Iowa.....	2,295,545.56	2,241,349.10		297.8
Kansas.....	2,088,099.23	2,085,241.57		150.1
Kentucky.....	1,874,533.90	1,750,680.26		267.1
Louisiana.....	1,045,811.69	1,035,963.10		48.0
Maine.....	926,000.11	842,403.50		69.9
Maryland.....	829,678.97	781,556.28		57.6
Massachusetts.....	477,469.65	469,741.41		15.2
Michigan.....	3,105,699.56	2,906,940.22		205.4
Minnesota.....	2,204,027.13	2,194,840.21		198.5
Mississippi.....	1,165,847.02	1,165,847.02		123.7
Missouri.....	2,761,470.20	2,686,006.24		497.7
Montana.....	1,760,235.26	1,751,640.86		225.9
Nebraska.....	1,972,044.00	1,957,240.00		263.6
Nevada.....	1,139,425.65	1,113,353.49		109.6
New Hampshire.....	491,947.70	448,385.73		24.2
New Jersey.....	56,527.92	55,098.73		5.5
New Mexico.....	1,235,197.98	1,235,197.98		205.0
New York.....	3,326,621.17	3,035,560.14		83.9
North Carolina.....	2,191,064.04	2,187,037.40		228.8
North Dakota.....	1,014,150.22	1,013,517.73		309.0
Ohio.....	4,012,658.13	3,754,142.44		296.3
Oklahoma.....	2,159,942.55	2,032,584.07		260.0
Oregon.....	1,641,441.88	1,501,340.67		104.1
Pennsylvania.....	6,428,967.73	6,260,218.79		541.3
Rhode Island.....	449,748.30	439,716.00		33.1
South Carolina.....	1,087,287.82	1,086,654.80		115.5
South Dakota.....	1,270,093.71	1,270,006.65		382.1
Tennessee.....	1,679,297.63	1,612,242.88		126.9
Texas.....	6,409,709.55	5,954,261.56		773.5
Utah.....	1,109,863.65	954,654.55		149.2
Vermont.....	505,615.68	438,631.41		36.4
Virginia.....	1,634,274.65	1,567,018.81		202.5
Washington.....	1,108,378.74	1,080,673.00		87.6
West Virginia.....	770,892.33	726,068.35		42.0
Wisconsin.....	2,298,476.16	2,158,518.02		167.6
Wyoming.....	1,064,861.09	1,047,457.51		145.4
District of Columbia.....	972,024.45	972,024.45		7.7
Hawaii.....	178,208.97	177,717.69		4.9
Total.....	83,452,001.19	79,670,018.68		7,948.1

TABLE 15.—Total cost and mileage of 1935 Public Works highway projects financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, completed to June 30, 1935, and Federal funds allotted thereto by States

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$35,889.47	\$35,889.47	-----	14.2
Arizona.....	471,297.49	458,904.66	-----	55.3
Arkansas.....	363,850.82	335,091.20	\$28,632.77	12.3
California.....	516,028.33	476,000.00	-----	72.5
Colorado.....	1,651,494.55	1,628,991.40	-----	86.2
Delaware.....	330,607.95	317,536.98	-----	12.2
Florida.....	264,419.89	264,419.89	-----	9.9
Georgia.....	424,650.91	424,650.91	-----	33.7
Idaho.....	155,805.70	154,028.23	-----	25.4
Illinois.....	143,134.98	142,889.96	-----	1.0
Indiana.....	35,317.13	35,317.13	-----	58.2
Iowa.....	333,105.29	314,620.00	-----	234.7
Kansas.....	780,967.83	780,018.60	-----	36.0
Kentucky.....	198,470.48	196,935.36	-----	.6
Louisiana.....	40,686.82	40,686.82	-----	3.4
Maine.....	93,719.61	93,719.61	-----	.7
Maryland.....	74,648.81	74,648.81	-----	2.6
Michigan.....	81,400.00	81,400.00	-----	162.4
Minnesota.....	1,448,053.98	1,365,524.47	-----	23.7
Mississippi.....	490,683.24	490,683.24	-----	186.7
Montana.....	1,566,794.43	1,566,280.97	-----	12.9
Nebraska.....	148,532.78	137,283.57	-----	62.2
Nevada.....	605,805.48	604,881.16	-----	1.8
New Hampshire.....	89,621.01	89,272.86	-----	89.7
New Jersey.....	42,612.52	15,000.00	-----	4.5
New Mexico.....	812,459.42	812,459.42	-----	44.9
New York.....	296,087.80	230,230.00	-----	160.9
North Carolina.....	679,374.10	392,190.26	287,183.84	3.9
North Dakota.....	245,708.08	218,195.17	27,254.54	20.2
Ohio.....	88,100.00	88,100.00	-----	11.1
Oklahoma.....	384,142.78	384,142.78	-----	12.5
Oregon.....	330,811.09	270,947.09	50,000.00	8.8
Pennsylvania.....	594,435.02	593,079.55	-----	70.5
South Carolina.....	111,964.67	111,964.67	-----	11.3
South Dakota.....	160,756.21	160,756.21	-----	78.7
Tennessee.....	333,219.48	333,219.48	-----	3.2
Texas.....	983,794.20	983,266.67	-----	19.0
Utah.....	677,675.01	553,524.55	85,000.00	3.7
Vermont.....	35,235.08	34,775.08	-----	7.2
Virginia.....	514,935.80	468,944.82	44,821.84	5.8
Washington.....	200,639.96	200,520.77	-----	58.5
West Virginia.....	195,860.50	195,860.50	-----	-----
Wisconsin.....	154,752.05	151,270.63	-----	-----
Wyoming.....	452,293.16	452,284.00	-----	-----
Total.....	17,639,933.89	16,770,456.95	522,892.99	1,814.9

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES<sup>2</sup>

Alabama.....	\$98,283.79	\$98,283.79	-----	2.2
Arizona.....	47,141.90	37,302.77	-----	1.0
Arkansas.....	70,342.15	70,342.15	-----	1.9
California.....	275,475.69	258,050.00	-----	7.7
Colorado.....	169,410.60	169,410.60	-----	4.6
Connecticut.....	10,077.96	9,362.04	-----	-----
Delaware.....	51,542.45	51,542.45	-----	.6
Florida.....	102,826.90	102,826.90	-----	2.7
Georgia.....	35,648.19	35,648.19	-----	1.7
Idaho.....	11,841.45	11,571.90	-----	1.8
Indiana.....	14,011.76	14,011.76	-----	.3
Iowa.....	75,627.57	71,035.00	-----	6.3
Kansas.....	180,411.35	176,992.33	-----	5.2
Kentucky.....	27,428.21	27,428.21	-----	1.8
Louisiana.....	61,390.74	61,390.74	-----	1.7
Michigan.....	104,400.00	104,400.00	-----	.6
Minnesota.....	290,146.65	288,822.11	-----	12.5
Mississippi.....	95,558.48	95,558.48	-----	3.3

<sup>1</sup> No projects of this class completed in States not listed, the District of Columbia, and Hawaii.<sup>2</sup> No projects of this class completed in States not listed and Hawaii.

TABLE 15.—Total cost and mileage of 1935 Public Works highway projects financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, completed to June 30, 1935, and Federal funds allotted thereto by States—Continued

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Missouri.....	\$18,790.55	\$18,790.55		0.2
Montana.....	32,919.00	32,919.00		
Nebraska.....	320,655.36	320,655.36		7.9
Nevada.....	49,331.47	49,331.47		8
New Hampshire.....	102,288.40	102,288.40		1.3
New Jersey.....	3,316.01	3,316.01		1.4
New Mexico.....	180,997.17	180,997.17		5.2
New York.....	338,700.00	338,700.00		2.4
North Carolina.....	541,177.44	536,087.26	\$5,090.18	16.7
North Dakota.....	1,163.70	1,163.70		8
Ohio.....	163,767.25	163,665.24		5.6
Oklahoma.....	199,101.74	199,101.74		3.6
Oregon.....	103,906.99	103,906.99		3.5
Pennsylvania.....	506,119.54	505,373.22		10.8
South Dakota.....	1,360.87	1,360.87		1.1
Tennessee.....	116,430.62	116,430.62		1.1
Texas.....	167,664.48	167,664.48		11.3
Utah.....	76,132.28	63,066.11		3.5
Vermont.....	37,526.82	36,000.00		7
Virginia.....	220,169.76	215,043.32	5,126.44	5.4
Washington.....	308,461.88	305,761.08		8.3
West Virginia.....	28,109.01	28,109.01		9
Wisconsin.....	123,788.47	123,788.47		3.9
Wyoming.....	2,784.76	2,784.00		2
District of Columbia.....	181,051.07	181,051.07		2.0
Total.....	5,546,380.48	5,480,434.56	10,216.62	153.5

PROJECTS ON SECONDARY OR FEEDER ROADS<sup>1</sup>

Alabama.....	\$92,973.82	\$92,973.82		7.0
Arizona.....	217,196.18	186,412.63		21.5
California.....	38,646.85	37,900.00		6.1
Colorado.....	555,225.58	277,323.58		93.7
Connecticut.....	12,888.94	12,888.94		4
Delaware.....	158,976.51	155,213.26		37.4
Florida.....	322,933.99	322,933.99		13.7
Idaho.....	144,223.51	135,239.87		19.8
Iowa.....	328,193.43	315,850.00		115.6
Kansas.....	141,391.73	141,391.73		77.4
Kentucky.....	279,409.82	275,369.30		31.1
Louisiana.....	101,176.02	101,176.02		2.5
Maine.....	320,207.73	319,273.85		28.5
Maryland.....	41,222.90	41,222.90		1.9
Michigan.....	39,700.00	39,700.00		3
Minnesota.....	558,120.92	484,888.55		100.9
Mississippi.....	10,000.00	10,000.00		6.5
Missouri.....	240,144.63	239,272.45		151.1
Montana.....	405,178.29	405,178.29		38.3
Nebraska.....	456,960.33	456,960.33		157.3
Nevada.....	353,854.51	352,874.33		75.8
New Hampshire.....	45,227.90	43,003.83		1.5
New Mexico.....	262,434.99	262,434.99		36.2
New York.....	354,223.99	209,288.61		9.1
North Carolina.....	458,052.48	458,052.48		61.1
North Dakota.....	46,073.64	46,073.64		13.4
Ohio.....	101,950.00	101,950.00		15.5
Oklahoma.....	50,770.15	50,770.15		11.3
Oregon.....	457,474.13	419,957.23		44.4
Pennsylvania.....	226,160.04	225,686.53		13.4
South Carolina.....	99,102.42	99,102.42		8.9
South Dakota.....	78,372.54	78,372.54		17.3
Tennessee.....	124,457.87	124,457.87		5.7
Texas.....	448,005.99	448,005.99		77.3
Utah.....	243,836.42	192,800.00		46.2
Vermont.....	57,539.15	57,503.82		3.1
Virginia.....	22,310.23	22,310.23		9.3
Washington.....	226,285.16	226,228.74		33.1
Wisconsin.....	48,583.45	48,583.45		2.8
Wyoming.....	135,377.42	135,376.00		11.4
District of Columbia.....	166,491.42	166,491.42		2.5
Total.....	8,471,355.08	7,820,498.78		1,410.3

<sup>1</sup> No projects of this class completed in States not listed and Hawaii.



TABLE 16.—*Total cost and mileage of 1934 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act, under construction June 30, 1935, and Federal funds allotted thereto, by States*PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$929,126.70	\$530,261.54	\$398,865.16	52.4
Arkansas.....	760,736.85	643,215.22	117,520.63	20.8
California.....	920,981.81	158,740.56	.....	5.2
Colorado.....	132,907.59	82,696.81	36,500.00	4.2
Connecticut.....	802,607.64	611,294.44	191,213.20	16.3
Delaware.....	4,973.04	4,973.04	.....	.....
Florida.....	258,441.11	220,894.89	37,546.22	2.3
Georgia.....	1,061,740.78	978,717.13	83,023.65	34.4
Idaho.....	143,741.95	131,758.66	11,983.29	4.7
Illinois.....	2,002,681.43	2,002,681.43	.....	16.6
Indiana.....	1,428,619.62	1,427,908.10	.....	28.2
Iowa.....	325,120.40	306,900.00	.....	10.0
Kansas.....	31,529.65	31,529.65	.....	5.0
Kentucky.....	392,181.39	316,513.72	13,361.92	13.1
Louisiana.....	515,017.51	369,904.43	.....	2.8
Maine.....	117,934.18	117,934.18	.....	.6
Maryland.....	797,232.25	797,232.25	.....	16.5
Massachusetts.....	52,686.97	52,686.97	.....	.3
Michigan.....	1,075,800.00	1,075,800.00	.....	40.1
Minnesota.....	192,247.59	192,247.59	.....	19.7
Mississippi.....	1,549,626.51	893,810.26	655,816.25	85.9
Missouri.....	9,080.70	861,589.21	73,112.40	14.3
Montana.....	64,686.16	4,129.31	32,001.66	19.3
Nebraska.....	252,801.31	25,639.51	.....	6.1
Nevada.....	157,644.11	157,644.11	.....	25.5
New Hampshire.....	96,866.55	79,729.64	17,136.91	.3
New Jersey.....	1,135,261.50	1,113,073.72	12,676.78	10.8
New Mexico.....	114,088.04	98,561.71	.....	5.0
New York.....	1,490,230.00	1,262,471.81	.....	28.2
North Carolina.....	907,820.89	775,849.23	131,871.66	81.4
North Dakota.....	161,368.12	98,160.47	63,207.65	40.9
Ohio.....	192,470.00	186,050.92	4,959.08	4.5
Oklahoma.....	515,959.55	396,183.38	119,776.17	21.4
Oregon.....	161,687.91	80,589.91	.....	.5
Pennsylvania.....	630,718.27	442,031.34	30,620.92	5.6
Rhode Island.....	88,003.07	79,739.61	.....	1.3
South Carolina.....	315,630.36	315,630.36	.....	28.4
South Dakota.....	519,142.31	466,318.32	32,823.99	78.1
Tennessee.....	272,948.05	176,546.93	14,299.75	5.0
Texas.....	424,980.99	387,980.99	.....	29.2
Utah.....	37,409.08	37,000.00	.....	.8
Vermont.....	27,413.87	10,670.21	.....	.4
Virginia.....	249,667.81	233,865.48	11,757.70	15.0
Washington.....	227,921.65	227,921.65	.....	7.6
West Virginia.....	57,156.19	57,156.19	.....	.2
Wisconsin.....	445,826.77	445,826.77	.....	21.1
Wyoming.....	208,543.19	182,391.43	25,660.00	3.5
Hawaii.....	1,331,572.45	1,126,854.57	183,588.47	20.3
Total.....	24,595,194.47	20,326,438.65	2,299,443.46	854.5

<sup>1</sup> No projects of this class under construction in Arizona and the District of Columbia.PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES<sup>2</sup>

Alabama.....	\$568,563.40	\$568,563.40	.....	20.4
Arkansas.....	249,166.70	248,966.79	.....	2.5
California.....	517,127.05	356,839.76	.....	.1
Florida.....	2,868.50	2,893.50	.....	.....
Georgia.....	315,541.40	308,553.95	\$6,987.45	7.7
Idaho.....	45,371.70	45,371.70	.....	.1
Illinois.....	1,202,053.81	1,202,053.81	.....	4.1
Indiana.....	1,075,628.48	1,073,184.60	.....	9.2
Iowa.....	645,327.36	600,765.25	.....	6.2
Kansas.....	71,884.18	71,884.18	.....	.6
Kentucky.....	453,136.59	450,583.92	.....	2.1
Louisiana.....	988,110.21	946,156.66	41,953.55	10.7
Maine.....	67,228.11	67,228.11	.....	1.0
Maryland.....	1,075,977.75	262,456.99	.....	.9
Massachusetts.....	2,901,347.79	2,876,371.63	24,976.16	3.4

<sup>2</sup> No projects of this class under construction in States not listed and Hawaii.

TABLE 16.—Total cost and mileage of 1934 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act, under construction June 30, 1935, and Federal funds allotted thereto, by States—Con.

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Michigan.....	\$360,750.00	\$357,250.00		2.4
Minnesota.....	607,095.94	520,812.92		1.3
Mississippi.....	839,119.69	764,058.20	\$46,061.49	19.9
Missouri.....	1,067,899.45	1,022,062.03		6.8
Montana.....	93,359.73	66,067.94	27,291.79	4.5
New Hampshire.....	71,558.80	71,558.80		1.8
New Jersey.....	182,690.19	182,690.19		.3
New Mexico.....	122,326.38	123,326.38		1.2
New York.....	1,050,661.42	887,217.02		4.2
North Carolina.....	155,690.18	125,112.60	30,577.58	4.8
North Dakota.....	238,526.73	238,526.73		7.5
Oklahoma.....	171,034.81	167,849.07		2.1
Oregon.....	74,643.86	66,634.90		1.0
Pennsylvania.....	681,120.30	592,456.56		2.4
South Carolina.....	268,167.47	252,616.63	5,550.84	10.8
South Dakota.....	183,141.89	183,141.89		7.1
Tennessee.....	371,898.49	371,898.49		2.7
Texas.....	1,401,142.64	1,244,952.30		7.8
Utah.....	129,468.43	129,130.39		.4
Vermont.....	26,801.55	26,801.55		.9
Virginia.....	883,957.26	634,441.09	8,276.21	3.6
Washington.....	48,798.52	48,798.52		1.0
West Virginia.....	307,661.19	307,661.19		3.5
Wisconsin.....	113,025.39	113,025.39		.1
Wyoming.....	141,589.33	141,009.00		1.8
District of Columbia.....	250,164.00	250,164.00		.2
Total.....	20,026,656.67	17,971,392.94	191,675.07	169.1

PROJECTS ON SECONDARY OR FEEDER ROADS<sup>3</sup>

Alabama.....	\$507,248.23	\$507,248.23		32.2
Arkansas.....	152,928.42	152,568.42		12.2
California.....	563,450.52	494,005.31		16.7
Colorado.....	185,664.57	110,000.00		10.1
Connecticut.....	504,634.08	498,838.50		11.5
Delaware.....	215,682.00	215,447.79		2.5
Georgia.....	620,787.73	620,787.73		41.3
Illinois.....	2,727,238.81	2,727,238.81		166.6
Indiana.....	310,432.90	310,432.90		43.4
Iowa.....	182,999.54	171,301.73		24.1
Kansas.....	393,660.62	393,660.62		12.6
Kentucky.....	67,732.52	67,732.52		12.0
Louisiana.....	260,029.86	260,029.86		11.3
Maryland.....	99,745.80	99,745.80		8.8
Michigan.....	241,227.00	241,227.00		19.0
Minnesota.....	149,443.85	149,443.85		4.5
Mississippi.....	543,534.41	543,534.41		39.4
Missouri.....	280,804.39	235,551.21		16.3
New Hampshire.....	29,000.00	29,000.00		1.3
New Mexico.....	36,931.02	36,931.02		8.2
New York.....	640,500.00	515,500.00		15.7
North Carolina.....	160,265.46	160,265.46		8.2
North Dakota.....	303,198.16	303,198.16		100.6
Ohio.....	32,860.00	32,860.00		5.6
Oklahoma.....	282,377.22	265,837.68		19.1
Oregon.....	19,525.71	19,525.71		.2
Pennsylvania.....	1,119,999.94	1,066,649.12		96.9
South Carolina.....	227,517.61	227,517.61		33.7
South Dakota.....	232,863.35	232,863.35		69.9
Tennessee.....	429,039.85	429,039.85		23.9
Texas.....	16,516.74	16,516.74		.8
Utah.....	108,127.25	94,022.45		12.1
Virginia.....	104,247.26	104,247.26		3.4
West Virginia.....	387,152.35	387,152.35		15.1
Wisconsin.....	331,847.48	258,460.28		16.5
Wyoming.....	33,501.60	33,494.00		8.5
Total.....	12,502,715.75	12,012,475.23		924.2

<sup>3</sup> No projects of this class under construction in States not listed, the District of Columbia, and Hawaii.

TABLE 17.—Total cost and mileage of 1935 Public Works highway projects financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, under construction on June 30, 1935, and Federal funds allotted thereto, by States

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$1,235,513.03	\$1,235,513.03	-----	71.6
Arizona.....	982,993.70	870,052.18	-----	42.4
Arkansas.....	1,142,590.59	973,714.66	\$168,255.93	69.2
California.....	2,266,719.22	2,119,795.23	-----	55.9
Colorado.....	825,069.05	786,221.95	-----	40.1
Connecticut.....	670,945.98	554,725.61	116,220.37	7.1
Delaware.....	133,550.00	133,550.00	-----	3.2
Florida.....	606,335.03	606,335.03	-----	27.9
Georgia.....	1,149,032.86	1,149,032.86	-----	70.7
Idaho.....	459,597.31	445,173.06	13,544.24	28.6
Illinois.....	1,987,890.38	1,987,890.38	-----	50.5
Indiana.....	2,443,414.04	2,279,625.42	18,274.51	135.1
Iowa.....	2,004,889.57	1,715,528.60	-----	108.1
Kansas.....	1,614,717.21	1,546,923.37	-----	120.2
Kentucky.....	801,217.07	792,538.75	4,534.97	43.6
Louisiana.....	1,105,850.67	1,098,700.05	-----	26.1
Maine.....	494,534.43	494,534.43	-----	9.5
Maryland.....	178,571.16	178,571.16	-----	4.8
Massachusetts.....	1,041,709.99	989,888.41	51,821.58	19.9
Michigan.....	2,371,800.00	2,350,736.48	21,063.52	95.0
Minnesota.....	737,717.12	737,117.12	-----	100.2
Mississippi.....	1,321,253.57	1,323,253.57	-----	74.2
Missouri.....	1,936,319.39	1,877,065.61	-----	70.5
Montana.....	1,017,215.99	975,696.17	41,519.82	52.3
Nebraska.....	1,872,142.32	1,748,711.97	-----	98.9
Nevada.....	499,452.95	498,785.75	-----	74.2
New Hampshire.....	356,384.03	352,131.53	-----	10.4
New Jersey.....	650,905.68	575,606.68	-----	4.4
New Mexico.....	562,945.51	562,945.51	-----	40.0
New York.....	6,055,080.00	3,246,551.69	58,928.31	109.2
North Carolina.....	598,824.90	545,824.90	53,000.00	75.3
North Dakota.....	521,041.33	409,315.43	111,725.90	162.7
Ohio.....	3,182,256.00	2,854,513.00	137,130.00	64.6
Oklahoma.....	1,521,275.03	1,428,536.88	30,238.15	58.5
Oregon.....	1,142,678.66	1,103,851.77	9,660.36	54.9
Pennsylvania.....	3,800,016.42	3,757,563.61	-----	75.5
Rhode Island.....	471,988.57	464,572.00	-----	13.0
South Carolina.....	351,415.73	351,415.73	-----	27.3
South Dakota.....	987,435.21	966,352.61	21,082.60	157.3
Tennessee.....	1,313,145.64	1,313,145.64	-----	50.7
Texas.....	4,727,034.13	4,564,419.90	162,614.23	343.8
Utah.....	468,962.67	360,550.00	53,499.15	28.3
Vermont.....	364,218.26	353,388.49	-----	62.2
Virginia.....	1,264,677.22	1,101,175.87	160,966.74	17.3
Washington.....	1,332,783.10	1,212,203.56	-----	16.0
West Virginia.....	456,667.87	456,667.87	-----	17.0
Wisconsin.....	1,611,152.33	1,531,644.27	-----	66.4
Wyoming.....	1,030,753.30	1,030,740.00	-----	193.3
Total.....	63,672,684.22	58,012,797.79	1,233,480.38	3,148.1

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES<sup>2</sup>

Alabama.....	\$282,641.23	\$282,641.23	-----	5.7
Arizona.....	107,876.87	95,500.39	-----	.6
Arkansas.....	328,005.98	326,803.48	-----	8.1
California.....	2,883,600.74	1,749,825.95	-----	13.3
Connecticut.....	193,691.99	142,520.92	\$51,171.07	1.6
Delaware.....	40,287.55	40,287.55	-----	1.8
Florida.....	154,249.88	154,249.88	-----	1.4
Georgia.....	415,349.19	405,048.89	-----	13.5
Idaho.....	206,182.04	204,994.04	-----	1.2
Illinois.....	1,016,233.62	1,016,233.62	-----	7.0
Indiana.....	996,082.11	996,082.11	-----	19.1
Iowa.....	848,067.63	795,665.00	-----	17.1
Kansas.....	1,260,279.49	1,244,976.69	-----	14.2
Kentucky.....	437,249.52	435,366.36	-----	6.6
Louisiana.....	273,259.85	273,172.19	-----	6.9

<sup>1</sup> No projects of this class under construction in Hawaii and the District of Columbia.<sup>2</sup> No projects of this class under construction in States not listed, the District of Columbia, and Hawaii.



TABLE 17.—Total cost and mileage of 1935 Public Works highway projects financed with funds provided by the Hayden-Cartwright Act of June 18, 1935, under construction on June 30, 1935, and Federal funds allotted thereto, by States—Con.

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Maine.....	\$197,218.30	\$197,218.30		2.0
Massachusetts.....	230,205.73	230,205.73		2.4
Michigan.....	1,316,500.00	1,291,100.00		15.4
Minnesota.....	445,116.77	436,916.77		16.5
Mississippi.....	106,745.37	106,745.37		6.9
Missouri.....	157,129.26	157,129.26		4.4
Montana.....	31,670.98	31,670.98		2.1
Nebraska.....	531,566.36	531,566.36		8.9
Nevada.....	8,510.76	8,510.76		.6
New Hampshire.....	79,386.37	79,176.37		2.1
New Jersey.....	879,675.15	641,127.27	\$19,000.00	4.8
New Mexico.....	69,432.03	69,432.03		1.7
New York.....	3,065,679.55	3,009,990.00		21.7
North Carolina.....	472,005.07	472,005.07		11.8
North Dakota.....	157,735.14	157,735.14		7.8
Ohio.....	1,661,797.00	1,533,452.00	6,030.00	15.4
Oklahoma.....	573,543.63	573,543.63		6.4
Oregon.....	591,819.38	591,819.38		9.9
Pennsylvania.....	1,006,691.49	972,115.31		12.7
Rhode Island.....	141,760.07	141,760.07		1.5
South Carolina.....	171,375.71	171,375.71		4.5
South Dakota.....	159,511.02	159,511.02		3.3
Tennessee.....	388,241.06	388,241.06		4.1
Texas.....	734,017.70	713,845.68	20,000.00	14.6
Utah.....	371,312.27	315,800.00		9.0
Vermont.....	163,645.98	149,376.31		2.4
Virginia.....	428,767.06	368,145.59	23,375.34	5.6
Washington.....	406,596.64	406,596.64		6.0
West Virginia.....	14,491.67	14,491.67		.7
Wisconsin.....	994,290.48	994,290.48		15.0
Wyoming.....	14,133.72	14,132.00		1.2
Total.....	25,013,629.41	23,092,394.26	119,576.41	339.5

PROJECTS ON SECONDARY OR FEEDER ROADS<sup>1</sup>

Alabama.....	\$635,657.33	\$635,657.33		44.1
Arizona.....	768,207.39	694,494.21		63.5
Arkansas.....	533,651.48	531,638.74		75.2
California.....	1,361,983.23	1,283,365.22		41.9
Colorado.....	621,244.72	504,962.72		66.7
Connecticut.....	222,880.06	222,880.06		4.5
Delaware.....	81,141.70	70,330.50		17.4
Florida.....	580,943.52	580,943.52		34.4
Georgia.....	342,922.74	342,922.74		29.6
Idaho.....	510,165.83	510,165.83		59.6
Illinois.....	3,004,914.00	3,004,914.00		145.3
Indiana.....	78,287.21	78,287.21		6.6
Iowa.....	1,425,508.86	1,222,625.00		246.5
Kansas.....	1,181,056.87	1,181,056.87		72.1
Kentucky.....	1,269,275.22	1,191,634.94		156.7
Louisiana.....	589,699.79	589,699.79		27.5
Maine.....	155,426.77	117,980.30		8.1
Maryland.....	378,167.35	378,167.35		15.5
Massachusetts.....	415,063.21	415,063.21		10.4
Michigan.....	1,458,017.00	1,458,017.00		63.0
Minnesota.....	929,772.62	824,872.62		95.7
Mississippi.....	62,278.91	62,278.91		11.3
Missouri.....	1,435,426.48	1,426,306.28		286.4
Montana.....	438,840.01	438,840.01		46.2
Nebraska.....	430,844.61	430,844.61		67.8
Nevada.....	244,477.73	244,477.73		24.5
New Hampshire.....	210,542.17	206,407.78		7.6
New Jersey.....	107,524.70	107,524.70		1.7
New Mexico.....	383,701.28	383,701.28		47.4
New York.....	3,954,270.00	3,403,050.00		267.8
North Carolina.....	966,921.63	966,921.63		117.5

<sup>1</sup> No projects of this class under construction in Hawaii.

TABLE 17.—Total cost and mileage of 1935 Public Works highway projects financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, under construction on June 30, 1935, and Federal funds allotted thereto, by States—Con.

## PROJECTS ON SECONDARY OR FEEDER ROADS—Continued

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
North Dakota.....	\$41,994.39	\$41,994.39	-----	8.4
Ohio.....	1,440,226.44	1,390,842.91	-----	90.3
Oklahoma.....	1,002,140.73	854,359.84	-----	34.6
Oregon.....	411,551.66	357,138.77	-----	21.7
Pennsylvania.....	2,325,212.07	2,275,713.75	-----	103.5
Rhode Island.....	212,562.56	212,562.56	-----	6.7
South Carolina.....	1,114,812.40	1,076,462.78	-----	125.2
South Dakota.....	288,987.69	288,987.69	-----	63.7
Tennessee.....	568,686.82	568,686.82	-----	27.4
Texas.....	2,876,616.78	2,876,596.78	-----	167.2
Utah.....	371,555.10	314,372.75	-----	59.0
Vermont.....	197,198.91	182,947.63	-----	13.7
Virginia.....	590,165.00	582,891.97	-----	61.2
Washington.....	556,609.68	549,109.68	-----	24.1
West Virginia.....	301,156.98	301,156.98	-----	11.7
Wisconsin.....	1,490,418.47	1,361,660.19	-----	43.7
Wyoming.....	332,065.94	332,063.00	-----	67.0
District of Columbia.....	337,624.96	337,624.96	-----	2.7
Total.....	39,238,401.00	37,415,205.54	-----	3,094.3

Of the 1,427 miles in projects approved for construction on June 30, 675 miles were located on the Federal-aid highway system outside of cities; 135 miles were made up of municipal extensions of the system; and 617 miles consisted of secondary or feeder roads. The distribution of these projects and other information concerning them are given in tables 18 and 19.

TABLE 18.—Total cost and mileage of 1934 Public Works highways financed with funds provided by sec. 204 of the National Industrial Recovery Act, approved for construction on June 30, 1935, and Federal funds allotted thereto, by States

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$37,465.80	\$37,465.80	-----	-----
Arkansas.....	159,288.77	158,918.77	-----	4.0
Colorado.....	77,584.98	6,627.34	-----	5.5
Delaware.....	4,158.00	4,082.00	-----	-----
Georgia.....	6,393.86	6,393.86	-----	-----
Illinois.....	3,000.00	3,000.00	-----	.1
Indiana.....	77,950.96	77,950.96	-----	-----
Louisiana.....	11,069.97	11,069.97	-----	.1
Maryland.....	106,646.45	106,646.45	-----	1.1
Minnesota.....	50,481.59	50,481.59	-----	5.4
Mississippi.....	5,574.32	5,574.32	-----	-----
Nevada.....	70,539.91	34,908.23	-----	25.8
North Carolina.....	64,450.00	64,450.00	-----	-----
North Dakota.....	198,227.80	148,353.30	\$49,871.50	65.9
Ohio.....	44,210.00	42,800.00	-----	.7
Oklahoma.....	16,345.48	10,819.53	-----	.1
Pennsylvania.....	2,291.36	2,126.23	-----	-----
South Carolina.....	18,520.00	18,520.00	-----	-----
South Dakota.....	21,653.14	17,186.63	4,466.51	5.9
Tennessee.....	2,195.35	2,195.35	-----	-----
Virginia.....	127,423.27	51,679.64	9,722.83	4.8
West Virginia.....	57,990.03	54,406.80	-----	.5
Wisconsin.....	79,906.70	25,000.00	-----	2.0
Hawaii.....	20,972.60	20,972.60	-----	.1
Total.....	1,264,340.34	961,632.37	64,660.84	122.0

<sup>1</sup> No projects of this class in this status in States not listed and the District of Columbia.

TABLE 18.—*Total cost and mileage of 1934 Public Works highways financed with funds provided by sec. 204 of the National Industrial Recovery Act, approved for construction on June 30, 1935, and Federal funds allotted thereto, by States—Con.*

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES<sup>1</sup>

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama	\$29,877.89	\$29,877.89		
Arizona	129,321.66	129,321.66		0.1
Arkansas	101,076.31	101,076.31		.2
Colorado	15,949.45	15,949.45		.8
Illinois	47,260.00	47,260.00		.6
Indiana	148,114.62	148,114.62		1.6
Kansas	48,918.42	48,918.42		1.3
Kentucky	35,577.81	30,000.00		
Louisiana	10,665.82	10,665.82		
Maine	58,912.31	58,912.31		.7
Michigan	19,400.00	19,400.00		.7
Minnesota	2,310.00	2,310.00		
Mississippi	9,152.16	9,152.16		.3
Montana	30,011.74	30,011.74		2.3
New Mexico	1,010.05	1,010.05		
New York	76,700.00	76,700.00		
North Carolina	91,217.00	91,217.00		.1
North Dakota	119,304.45	119,304.45		7.4
Ohio	121,000.00	93,351.86		1.1
Oklahoma	57,563.80	35,870.76		.7
Oregon	517.97	517.97		
South Carolina	26,797.84	19,297.84	\$7,500.00	
South Dakota	55,948.23	55,948.23		1.5
Tennessee	11,070.59	11,070.59		.7
Texas	52,836.01	52,836.01		.5
Virginia	14,212.90	13,975.31		.1
West Virginia	39,253.65	28,642.41	10,611.24	.6
Wisconsin	57,664.33	57,664.33		.8
Wyoming	6,658.19	6,658.19		.4
Total	1,418,303.20	1,345,035.38	18,111.24	22.5

PROJECTS ON SECONDARY OR FEEDER ROADS<sup>2</sup>

Arizona	\$66,269.29	\$45,000.00		6.2
Colorado	3,197.17	3,197.17		.6
Illinois	9,847.75	9,847.75		8.3
Kansas	43,498.81	43,498.81		1.6
Louisiana	127,387.43	127,387.43		3.9
Maryland	13,941.95	9,800.00		1.5
Nevada	28,163.30	20,813.31		11.2
North Dakota	78,423.37	78,423.37		26.2
Ohio	17,000.00	17,000.00		2.0
South Carolina	36,000.00	36,000.00		5.9
Tennessee	17,894.47	17,894.47		.5
Texas	28,743.13	18,000.00		9.9
Virginia	74,549.90	65,504.17		1.7
Wyoming	42,657.78	41,790.00		22.0
Total	587,574.35	534,156.48		101.5

<sup>1</sup> No projects of this class in this status in States not listed, the District of Columbia, and Hawaii.



TABLE 19.—Total cost and mileage of 1935 Public Works highways financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, approved for construction on June 30, 1935, and Federal funds allotted thereto, by States

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES <sup>1</sup>

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
Alabama.....	\$459,429.26	\$459,429.26	.....	15.5
Arkansas.....	138,897.46	138,897.46	.....	5.8
California.....	873,410.05	826,273.20	.....	21.3
Delaware.....	7,441.50	7,441.50	.....	.....
Florida.....	214,469.80	214,469.80	.....	1.7
Georgia.....	240,661.00	240,661.00	.....	4.6
Idaho.....	331,023.33	283,675.90	.....	13.7
Illinois.....	280,271.00	277,997.66	.....	3.3
Indiana.....	601,199.50	383,180.35	.....	21.8
Iowa.....	60,517.39	56,500.00	.....	4.0
Kansas.....	27,300.37	27,188.53	.....	1.3
Kentucky.....	263,116.82	234,306.90	.....	11.2
Louisiana.....	1,326.42	1,326.42	.....	1.1
Maine.....	192,303.41	192,288.71	.....	6.8
Massachusetts.....	5,350.56	5,350.56	.....	.....
Michigan.....	579,025.00	579,025.00	.....	26.6
Minnesota.....	286,751.73	284,628.56	.....	36.3
Mississippi.....	694,396.44	684,578.30	.....	34.6
Missouri.....	1,127,079.33	1,013,600.39	.....	41.0
Montana.....	129,644.78	129,644.78	.....	2.2
Nebraska.....	40,817.00	40,817.00	.....	4.4
Nevada.....	259,726.99	234,342.21	.....	34.5
New Jersey.....	10,167.47	10,167.47	.....	.....
New Mexico.....	303,654.41	301,364.07	.....	18.6
New York.....	26,900.00	26,900.00	.....	.....
North Carolina.....	377,705.56	367,268.70	.....	19.0
North Dakota.....	323,136.54	258,265.54	\$64,871.00	91.7
Ohio.....	4,070.00	3,420.00	.....	1.1
Oklahoma.....	367,151.21	367,151.21	.....	11.1
Pennsylvania.....	8,497.72	6,816.00	.....	.....
South Carolina.....	27,220.10	27,220.10	.....	3.3
South Dakota.....	283,886.49	272,886.49	11,000.00	31.1
Tennessee.....	412,889.66	412,889.66	.....	9.1
Texas.....	810,726.03	658,162.52	.....	47.1
Utah.....	22,528.72	15,000.00	.....	1.1
Vermont.....	82,679.65	68,421.44	.....	1.7
Virginia.....	233,021.50	189,120.82	42,426.89	8.6
Washington.....	130,298.52	130,298.52	.....	3.3
West Virginia.....	119,086.55	119,086.55	.....	4.2
Wisconsin.....	95,747.24	92,795.83	.....	4.8
Wyoming.....	158,392.71	158,392.00	.....	20.9
Hawaii.....	273,416.37	273,416.37	.....	1.6
Total.....	10,882,335.59	10,074,066.78	118,297.89	553.0

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES <sup>2</sup>

Alabama.....	\$134,766.13	\$134,766.13	.....	2.0
Arizona.....	138,364.63	110,505.00	.....	1.1
Arkansas.....	200,919.11	200,693.61	.....	4.3
California.....	105,954.28	100,000.00	.....	1.6
Connecticut.....	134,613.11	134,613.11	.....	1.3
Georgia.....	149,961.03	143,961.03	.....	3.0
Illinois.....	613,618.00	613,618.00	.....	2.6
Indiana.....	835,239.08	835,239.08	.....	10.3
Iowa.....	166,512.39	158,535.00	.....	1.4
Kansas.....	10,979.98	10,979.98	.....	.....
Kentucky.....	242,923.86	215,702.18	.....	3.9
Louisiana.....	272,960.25	272,960.25	.....	3.6
Maine.....	286,017.87	280,253.42	.....	3.2
Massachusetts.....	38,076.83	38,076.83	.....	7.7
Michigan.....	120,500.00	120,500.00	.....	1.6
Minnesota.....	12,581.19	12,581.19	.....	1.3
Mississippi.....	30,896.51	30,896.51	.....	1.3
Missouri.....	747,677.05	743,232.48	.....	5.4
Montana.....	7,552.82	7,552.82	.....	7.7
Nebraska.....	343.81	343.81	.....	.....
New Hampshire.....	50,934.65	50,934.65	.....	3.3
New Jersey.....	119,047.71	104,945.64	.....	.....
New York.....	62,000.00	62,000.00	.....	.....

<sup>1</sup> No projects of this class in this status in States not listed and the District of Columbia.<sup>2</sup> No projects of this class in this status in States not listed, the District of Columbia, and Hawaii.

TABLE 19.—Total cost and mileage of 1935 Public Works highways financed with funds provided by the Hayden-Cartwright Act of June 18, 1934, approved for construction on June 30, 1935, and Federal funds allotted thereto, by States—Con.

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—(Continued)

State	Estimated total cost	Federal funds allotted		Mileage
		Public Works funds	Federal-aid funds	
North Carolina.....	\$135,599.56	\$135,599.56	-----	3.8
North Dakota.....	177,547.15	177,547.15	-----	12.0
Ohio.....	191,200.00	191,200.00	-----	1.3
Oklahoma.....	129,270.52	129,270.52	-----	2.0
Oregon.....	116,472.40	80,000.00	-----	.2
Pennsylvania.....	288,956.14	288,881.34	-----	.9
South Carolina.....	103,791.13	103,791.13	-----	1.2
South Dakota.....	104,395.23	104,395.23	-----	5.6
Tennessee.....	355,676.78	355,676.78	-----	3.1
Texas.....	569,417.84	476,685.47	-----	12.6
Utah.....	185,933.96	152,000.00	-----	4.8
Vermont.....	29,577.46	27,844.26	-----	.9
Virginia.....	308,594.12	288,438.77	-----	7.5
Washington.....	43,513.24	43,513.24	-----	.2
West Virginia.....	216,075.42	216,075.42	-----	3.4
Wisconsin.....	238,352.41	238,352.41	-----	3.9
Total.....	7,676,863.65	7,392,161.90	-----	112.0

PROJECTS ON SECONDARY OR FEEDER ROADS<sup>1</sup>

Alabama.....	\$194,367.07	\$194,367.07	-----	12.0
Arizona.....	10,000.37	10,000.37	-----	.9
Arkansas.....	173,729.35	173,440.85	-----	24.4
California.....	474,025.01	455,377.32	-----	14.8
Colorado.....	89,215.70	89,215.70	-----	.6
Florida.....	125,376.15	103,590.73	-----	6.8
Georgia.....	158,613.12	158,613.12	-----	5.9
Illinois.....	994,669.61	994,669.61	-----	19.1
Indiana.....	30,838.97	30,838.97	-----	5.7
Iowa.....	162,358.51	51,400.00	-----	16.3
Kansas.....	8,146.90	8,146.90	-----	-----
Kentucky.....	52,920.99	49,903.55	-----	4.7
Louisiana.....	129,771.72	129,771.72	-----	5.4
Maryland.....	176,375.65	176,375.65	-----	2.6
Massachusetts.....	115,369.59	115,369.59	-----	5.5
Michigan.....	115,425.00	115,425.00	-----	12.9
Minnesota.....	70,695.43	70,695.43	-----	7.7
Mississippi.....	133,134.20	133,134.20	-----	14.1
Missouri.....	698,342.98	698,342.98	-----	110.6
Montana.....	42,981.12	42,981.12	-----	5.2
Nebraska.....	37,135.70	37,135.70	-----	4.6
New Mexico.....	73,134.74	73,134.74	-----	2.6
North Carolina.....	120,716.85	120,716.85	-----	5.4
North Dakota.....	196,748.61	196,748.61	-----	44.5
Ohio.....	27,200.00	27,200.00	-----	6.2
Oklahoma.....	91,282.66	91,282.66	-----	8.7
Rhode Island.....	36,815.04	36,815.04	-----	1.4
South Carolina.....	99,939.65	99,939.65	-----	8.3
South Dakota.....	228,182.75	228,182.75	-----	71.1
Tennessee.....	106,608.97	106,608.97	-----	5.5
Texas.....	316,776.54	226,000.00	-----	18.3
Utah.....	34,437.15	25,000.00	-----	2.9
Virginia.....	257,744.14	239,410.85	-----	22.0
West Virginia.....	93,523.82	93,523.82	-----	9.9
Wisconsin.....	247,493.39	213,228.93	-----	6.2
Wyoming.....	83,413.14	83,411.91	-----	22.9
Total.....	5,997,510.59	5,700,000.36	-----	515.7

<sup>1</sup> No projects of this class in this status in States not listed, the District of Columbia, and Hawaii.

The classification of the mileage of Public Works highway projects by surface types is shown for each of the States and each class of project completed in table 20. Similar information concerning projects under construction at the end of the fiscal year is given in table 21, and projects approved for construction at the close of the year are shown in table 22.

TABLE 20.—*Mileage of 1934 and 1935 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act and the Hayden-Carwright Act of June 18, 1934, completed, by types of construction, by States, June 30, 1935*

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES

State	Graded and drained	Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)	
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated								Rail-road-way	High-way
	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Number	Number
Alabama	18.3	35.3	13.6	41.9				128.7	30.1	67.8			1.5	340.2	1	
Arizona	23.0		113.1					206.3	7.4	.8			3.0	352.6	4	
Arkansas	13.0		64.7					9.0	25.6	49.5			2.4	165.1	3	
California	18.2		222.5	30.0			15.7	90.3	114.1	38.5			2.9	364.1	7	3
Colorado	5.3		3.8					2.7		9.8			2.6	242.9	17	
Connecticut									7.7	2.9			.1	14.5		
Delaware	6.3								.3	39.9			.1	45.6		
Florida	19.8						41.4	31.0		33.1			.3	125.6	1	
Georgia	21.6	45.4	39.9	79.7			57.7	20.2	5.0	47.4			2.1	319.0	2	2
Idaho	7.5		103.0					81.6	.5	5.4			.5	198.5	2	
Illinois	18.0											1.8		40.3	25	1
Indiana	18.0		5.0					5.0	1.6	86.9			3.4	112.9	4	
Iowa	109.8		70.9							1.3			1.3	317.3	9	
Kansas	233.3	248.8	37.1							128.7			2.9	637.4	1	
Kentucky	36.6		103.0	7.5				53.4	13.8	62.3		3.3	2.6	290.5	2	
Louisiana	9.1		2.3	17.3				.5		69.7			1.0	76.8		
Maine										55.2			.6	47.4		
Maryland									5.9	1.8			.1	15.5		
Massachusetts	28.9		75.7						9.6	5.2			.1	37.4		
Michigan	125.7		567.4	47.0					1.6	8.9			.6	234.2	1	
Minnesota	14.1		8.2					44.4	.5	128.5			.5	910.1	14	
Mississippi	104.1	10.4	31.2	12.8						60.2			3.8	293.2	4	
Missouri	30.7		423.8						9.6	145.7			1.0	198.1	7	
Montana	30.6							92.4		9.2			2.4	564.4	11	1
Nebraska	53.5	117.2						56.4		99.8		.9	1.6	399.4	2	
Nevada			110.8					210.4	.6				.7	322.5	4	
New Hampshire							5.2		.9	3.1			.9	12.6	4	
New Jersey	4									36.9			.1	37.4	3	
New Mexico	12.4		32.3	171.6				111.6	32.8	1.1			2.1	363.9	1	
New York	12.7		2.4						43.9	164.0			.9	221.0	7	
North Carolina	14.8	52.7	185.7	113.0			67.7	53.3	27.8	27.8			1.1	602.7	3	2
North Dakota	463.3		568.8					89.7					.6	1,122.4	4	
Ohio	1.1		15.6						15.7	27.3			3.4	1,195.2		



## PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES

Oklahoma	182.8	31.8	22.9	.1	5.0	108.8	31.0	38.8	4.9	2.9	318.1	4
Oregon	27.0	16.4	11.2			8.7	9.2	13.8		1.5	193.9	3
Pennsylvania	9.8					8.5	26.8	90.5		1.1	139.9	2
Rhode Island						3.0		10.2			20.5	
South Carolina	14.6	167.0						15.6		.9	217.0	6
South Dakota	253.5	174.0				15.9		26.5		.7	556.1	1
Tennessee	40.4	9.8				5.1	17.3	107.9		1.5	192.2	3
Texas	650.3	138.7	132.1		7.4	11.3	51.2	117.0	2.1	7.6	1,117.7	14
Utah		33.3					23.7	35.5		.7	273.9	3
Vermont		9.1				28.5		7.4		.3	48.0	
Virginia	12.1	39.6	4	4.2	78.1	5.0	4.2	17.3		2.4	165.1	13
Washington	20.8	42.3				.5		41.8		1.0	106.4	5
West Virginia	23.6	4.2			10.0			44.9		.5	79.3	3
Wisconsin	7.3	41.7				37.0	1	115.4		1.1	214.8	7
Wyoming	17.3	161.1	4.4			332.2		3		.1	515.8	1
Hawaii											19.2	
Total	2,822.1	483.4	694.8	104.7	289.1	2,003.6	536.1	2,276.2	31.6	74.2	13,337.7	210
												9

Alabama					1.3	13.4	5.9	18.1	0.8	0.2	46.1	4
Arizona						5.9	3.9	3.7		.1	14.2	2
Arkansas						1.9	10.1	29.8		.4	44.4	1
California	0.2					4.0	40.1	15.5		.6	60.2	2
Colorado					1.1	2.0	13.4	16.1		.5	39.9	3
Connecticut							6.0	3.7			10.2	
Delaware							2.2	5.1			7.3	
Florida	1.4				3.9		1.5	15.2		.4	21.4	4
Georgia	1.9				23.1	7.5	1.5	19.2	.7	1.2	70.0	6
I Idaho							4.8	2.2		.2	20.1	3
Illinois						1.5	16.9	40.7	7.7	1.1	66.4	13
Indiana						1.9	29.7	31.9		.7	63.8	1
Iowa	8.0					.5	4.7	37.2	4.4	1.7	57.4	10
Kansas	7.2	5.3				5.6	11.5	19.5	4.2	.6	42.3	4
Kentucky	1.4							14.6		.2	34.2	
Louisiana	3.5							14.9		.1	20.2	1
Maine								4.4			16.4	
Maryland							2.5				3.6	
Massachusetts							3.5	4.0		1.0	13.4	1
Michigan	1.1						4.1	24.5	.8	.3	39.6	3
Minnesota	15.0						13.1	21.6	1.3	.7	110.8	14
Mississippi	11.1							11.4	1.2	.2	32.0	3
Missouri	1.6							32.5		.9	51.9	5
Montana								3.6		.2	34.0	4
Nebraska								27.3	2.9	.2	40.9	2
Nevada	4.0	3.3						2.4			10.2	
New Hampshire								14.5			16.9	
New Jersey								20.0	.7	.1	22.9	3
New Mexico								5.0		1.0	39.0	5
New York	8.0							34.2	.7	.9	60.4	14

TABLE 20.—*Mileage of 1934 and 1935 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act and the Hayden-Cartwright Act of June 18, 1934, completed, by types of construction, by States, June 30, 1935—Continued*

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Graded and drained	Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)	
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated								Rail-road-way	High-way
	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Number	Number
North Carolina.....	1.3	2.2	12.0	0.7	6.6	4.4	3.1	1.4	24.8	34.2	34.2	0.4	91.7	9	9	
North Dakota.....	6.7			8.4			18.7		3.2	9.4	46.6	0.2	46.6	1	1	
Ohio.....	.9			1.6					10.8	21.9	65.0	.8	65.0	1	1	
Oklahoma.....	4.7			1.2					11.9	20.3	48.3	.3	48.3	2	2	
Oregon.....	.6				1.7		.5		8.5	14.1	38.2	.4	38.2	3	3	1
Pennsylvania.....							.2		4.2	23.0	69.4	.8	69.4	4	4	
Rhode Island.....								3.0	27.7	30.1	7.4		7.4			
South Carolina.....	1.5		13.4	1.6			3.2		7.8	8.5	34.5		34.5	3	3	
South Dakota.....	3.5			.3			6.3		24.8	14.3	36.8	.6	36.8	2	2	
Tennessee.....	25.2			9.4	25.2				24.1	38.0	128.8	1.1	128.8	19	19	
Texas.....				.9			1.5		2.7	14.7	20.2	1.4	20.2	1	1	
Utah.....							1.4		2.6	8.0	14.4	.2	14.4			
Vermont.....		1.5	1.8		.7	1.0	10.6		8.5	4.8	30.5	.6	30.5	5	5	
Virginia.....				3.0					7.7	25.6	40.4	.6	40.4	4	4	1
Washington.....	1.5			5.8					6.1	8.8	17.7		17.7	1	1	
West Virginia.....							2.0		7.2	37.1	55.5	1.3	55.5	2	2	
Wisconsin.....	2.1						8.7		4.2	22.6	22.6	.1	22.6			
Wyoming.....									3.8		6.5		6.5			
District of Columbia.....																
Total.....	113.6	12.3	40.2	117.1	75.4	3.8	49.7	128.1	48.5	402.4	836.4	53.4	22.6	1,903.5	158	28

PROJECTS ON SECONDARY OR FEEDER ROADS

State	Graded and drained	Sand-clay	Gravel	Macadam	Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)
	Miles	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Miles	Miles	Number
Alabama.....	9.4	23.8	22.0	40.6	6.2	8.7	0.8	3.0		1.4	116.2	3
Arizona.....	16.5			9.0				39.2		.6	65.3	2
Arkansas.....				148.0						.9	149.1	
California.....	22.9			17.6						1.6	170.4	
Colorado.....	11.2			220.2	11.8			18.2		.6	232.0	
Connecticut.....								3.5			3.5	
Delaware.....				49.6				.9		.1	51.5	1

	23.8	7.6	7.4	72.0	20.9	34.0	22.1		.8	.4	88.5	2
Florida.....	8.7			135.5	13.4	4.1	4.6		4.2	1.0	122.1	
Georgia.....	11.8			113.7	1.4		28.5		23.0	2.8	164.1	12
Idaho.....	219.0			132.2			7.3		3.1	1.4	44.1	
Illinois.....	132.2			150.2			29.6		12.6	1.4	41.4	
Iowa.....	143.4			13.0			1.3		7.4	1.0	227.8	2
Kansas.....	114.4			108.2					3.0	1.0	238.2	1
Kentucky.....	1.1			10.7					12.1	.6	50.5	1
Louisiana.....				95.8	1.9				23.5	.6	98.4	
Maine.....	1.4	1.2	3.0	13.1	2.1	7.8	3.6	20.2	1.3	.1	39.5	
Maryland.....							3.7	11.5	5.7		15.2	
Massachusetts.....	14.4			182.8					18.8	.4	265.7	
Michigan.....	151.5			138.3			3.9		18.9	.5	249.4	
Minnesota.....	36.7	23.5		61.5	5.2				5.2	1.3	130.2	
Mississippi.....	415.0			229.9			8		.5	2.1	648.8	1
Missouri.....	3			237.1			25.2		1.1	.5	264.2	1
Montana.....	160.2	233.6					9.0		17.2	.9	420.9	
Nebraska.....							55.9		.5	.5	155.4	1
Nevada.....			.7	125.0		24.3		.5		.2	25.7	
New Hampshire.....									.5		5	
New Jersey.....	7.5	10.0		217.7	5.6		6.2			.4	241.2	
New Mexico.....				12.5			17.6		19.0	.5	93.0	
New York.....		82.0	90.3	53.2	23.9	9.5				.8	284.9	
North Carolina.....	77.7			243.9					8		322.4	
North Dakota.....	2.2			236.7	.9	.4	10.1	5.4	18.3	.8	311.8	1
Ohio.....	31.8			175.7	13.6		11.7		20.4	1.5	271.3	1
Oklahoma.....	11.7			43.7	28.9	21.7		44.4	.7	1.7	152.5	1
Oregon.....			3.1		32.6	189.6		306.4	14.1	.4	554.7	1
Pennsylvania.....					33.1						33.1	
Rhode Island.....	14.5	7.1	98.9		3.6					.3	124.4	
South Carolina.....	68.5			398.7						.2	397.4	
South Dakota.....	6.3			50.6			4.7	38.8	14.5	.6	132.6	
Tennessee.....	397.5			157.1	119.9	4.2	5.1	12.5	18.8	3.6	850.8	8
Texas.....				150.3			31.7		2.8	.1	195.4	1
Utah.....	3.7			5.6			28.2	1.7		.3	39.5	1
Vermont.....		42.3	56.1	29.7	26.6	16.5	31.5	2.9	1.0	1.0	211.8	
Virginia.....	8.0			86.4			3.4	3.4	1.7	.2	100.7	2
Washington.....				8.5			1.7		.4	.1	42.0	
West Virginia.....	2.8			71.0			53.0		43.2	.4	170.4	1
Wisconsin.....				135.0	8.1		13.3			.4	156.8	
Wyoming.....									6.0		10.2	
District of Columbia.....								4.9			4.9	
Hawaii.....												
Total.....	2,003.4	494.8	280.8	4,180.1	338.9	343.2	556.2	457.8	315.8	33.7	9,388.4	44
									8.4			1





PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES!

Ohio	2.2	4.8	3																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	</
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State	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020
Alabama	2.1	5.9	0.5	5.1	0.4	7.6		0.9	3.6			26.1	1
Arizona								1.2	3			0.1	1
Arkansas			.2			1.6		1.7	5.7			10.6	2
California					1.2	2.6		6.6	2.3			13.4	4
Connecticut								1.6				1.6	1
Delaware									1.8			1.8	
Florida		1.4		1.7	11.2			7	5.6			1.4	
Georgia			1.1					1.1	2			21.2	1
Idaho									8.2			1.3	1
Illinois	1.0							4.0	21.1	1.2		11.1	10
Indiana	.3								18.6	1.1		29.3	5
Iowa	1.6		.6						9.3	1.0		23.3	5
Kansas	1.4	1.1				.6		9	4.7			14.8	2
Kentucky								3.8	8.2			8.7	
Louisiana	8.8			.3				.6	1.9			17.6	
Maine							0.4					3.0	
Maryland								4		.1		9	
Massachusetts							.8	1.0	2.8			5.8	1
Michigan	.1		1					2.0	15.5			17.8	3
Minnesota	3.0		3.6			4.4		1.8	4.9			17.8	3
Mississippi	10.2	.9	1.3	3.6				4.2	10.0			26.8	6
Missouri	.4		.8			5.8			7.4			11.2	3
Montana								.5				6.6	2
Nebraska	.4		.6									8.9	2
Nevada												.6	
New Hampshire												3.9	3
New Jersey					3.8			4	4.6			5.1	

<sup>1</sup>No projects in this class in this status in Colorado and Hawaii.

TABLE 21.—*Mileage of 1934 and 1935 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act and the Hayden-Carwright Act of June 18, 1934, under construction, by types of construction, by States, June 30, 1935—Continued*

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Graded and drained	Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Port-land cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)	
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated								Miles	Number
New Mexico	4.5								4.2		0.5				2.9	1
New York	4.4	0.7	2.4						3.4	3.4	13.4		0.1		25.9	3
North Carolina	1.3						2.8		1.7		8.2		.4		16.6	2
North Dakota	1.3							11.0			1.1	0.7			15.3	
Ohio	3.3									4.9	4.1	5.6			15.4	
Oklahoma	1.7									3.3	5.6				8.5	
Oregon									2.8	3.3	4.6		.5		10.9	
Pennsylvania									2.8	1.6	9.5	1.0	.2		15.1	2
Rhode Island								.8	3.6		4.8				1.5	
South Carolina	3.2							2.3			4.4		.1		15.3	2
South Dakota										3.1	3.4		.2		10.4	2
Tennessee	2.8									1.5	8.9	1.4	.7		6.8	
Texas										5.0	3.0				22.4	5
Utah								.5		3.3	2.3				9.4	2
Vermont															3.3	
Virginia										3.3	1.3	.1	.1		5.2	1
Washington	1.6									3.3	4.4		.5		9.2	2
West Virginia	1.6									.9	2.1		.1		7.0	2
Wisconsin	.5							.6			2.1		.1		4.2	2
Wyoming								3.0		1.3	8.8		.4		15.1	1
District of Columbia															3.0	
Total	44.2	2.0	16.4	19.7	20.6	.9	22.5	40.8	11.6	67.6	234.3	12.2	15.8	598.6	75	15

PROJECTS ON SECONDARY OR FEEDER ROADS

Alabama	9.5										0.3				76.3	
Arizona	4.4										1.1				63.5	1
Arkansas											1.0				87.4	
California											3.4		.8		98.6	1





TABLE 22.—*Mileage of 1934 and 1935 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act and the Hayden-Cartwright Act of June 18, 1934, approved for construction, by types of construction, by States, June 30, 1935*

PROJECTS ON THE FEDERAL-AID SYSTEM OUTSIDE OF MUNICIPALITIES<sup>1</sup>

State	Graded and drained	Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Port-land cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)	
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated								Rail-road-high-way	High-way-highway
	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Miles	Number	Number
Alabama.....														15.5		
Arkansas.....			13.5								1.9		0.1	9.8		
California.....	8.3		3.0							2.3	4.4		.1	21.3	1	
Colorado.....								5.1			7.4		.5			
Florida.....	1.7		5.5											5.5		
Georgia.....														1.7		
Idaho.....														4.6		
Illinois.....	13.5		3.0							1.3			.3	13.7		
Indiana.....			13.5										.1		3	
Iowa.....	3.5										.3			4.0		
Kansas.....	1.2										.5			1.3		
Kentucky.....	6.5		1.2					.1			3.5			11.2		
Louisiana.....											.2			2.2		
Maine.....							6.8							6.8		
Maryland.....														1.1		
Michigan.....			2.9							2.0	2		.9	26.6		
Minnesota.....	.7		5.4					3.4		32.2	21.7			41.7		
Mississippi.....	3.6		11.5		15.0						4.1		.4	34.6		
Missouri.....	7.8		16.3					.1			16.8			41.0		
Montana.....														2.2		
Nebraska.....											.3		.1	.4		
Nevada.....								60.3						60.3		
New Mexico.....			18.6											18.6		
North Carolina.....		6.9						6.4			2.2			19.0		
North Dakota.....	24.2		93.5		32.4			7.5						157.6		
Ohio.....											8			8		
Oklahoma.....	6.8										4.2		.2	11.2		
South Carolina.....											.3			3		
South Dakota.....	6.8		10.0					16.1			4.0		.1	37.0		

# PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES

[illegible]

State	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	2020
Alabama	0.6												2.0
Arizona													2.2
Arkansas				1.2							0.3		1.5
California													1.6
Colorado	.8												.8
Connecticut	.6												1.3
Georgia													3.0
Illinois													3.2
Indiana	0.6			.2									2
Iowa	.5												3.0
Kansas													1.4
Kentucky													1.3
Louisiana	.1												1.3
Maine													3.6
Massachusetts													3.9
Michigan	.7			.6									7
Minnesota					0.4								1.3
Mississippi													1.0
Missouri	1.9			.6							.1		3.0
Montana	.7			2.3									3.3
New Hampshire													3.9
North Carolina	.3			.4									19.4
North Dakota	7.0			11.1	.7						.1		2.4
Ohio													2.7
Oklahoma											.2		2
Oregon													.9
Pennsylvania													1.2
South Carolina													7.1
South Dakota	1.4			2.2									3.8
Tennessee													13.1
Texas	1.6				4.0								4

1 No projects in this class in this status in States not listed and the District of Columbia.



TABLE 22.—*Mileage of 1934 and 1935 Public Works highway projects financed with funds provided by section 204 of the National Industrial Recovery Act and the Hayden-Carwright Act of June 18, 1934, approved for construction, by types of construction, by States, June 30, 1935—Continued*

PROJECTS ON EXTENSIONS OF THE FEDERAL-AID SYSTEM INTO AND THROUGH MUNICIPALITIES—Continued

State	Graded and drained	Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Port-land-cement concrete	Block	Bridges and approaches	Total	Grade-separation structures (mileage shown with bridges)	
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated								Rail-road-way	High-way
Utah.....	Miles			Miles		Miles		Miles		Miles		Miles		Miles	Number	Number
Vermont.....																
Virginia.....																
Washington.....																
West Virginia.....			0.4													
Wisconsin.....	0.6														1	
Wyoming.....	.3							1.2		.9		2.0		4.0		
Total.....	4.6		.6	14.1	5.1		4.1	19.9	0.9	24.5	57.6	0.8	2.3	134.5	16	7

PROJECTS ON SECONDARY OR FEEDER ROADS :

Alabama.....	2.7			8.3	0.9								0.1	12.0		
Arizona.....	.9			6.2										7.1		
Arkansas.....				23.9										24.8		
California.....	.1			5.4	.4			7.3			0.4		.1	14.8		
Colorado.....				1.2							1.4		.2	14.9		
Florida.....														6.8		
Georgia.....								6.8			1.7			6.8		
Illinois.....	2.8			15.3				4.2			8.3		1.0	27.4	1	
Indiana.....	4.9													5.7		
Iowa.....	7.5			8.6									.2	16.3		
Kansas.....											1.6			1.6		
Kentucky.....	2.2							2.5						4.7		
Louisiana.....				.8	2.6						5.9			9.3		
Maryland.....				1.5							2.6			4.1		



It will be noted that the completed projects included 412 structures separating the grades of railroads and highways at intersections and 38 highway-highway grade-separation structures. In course of construction at the close of the year were 196 other railroad-highway grade-separation structures and 18 structures eliminating level intersections of highways. To these will be added the 24 railroad-highway and 7 highway-highway structures shown in table 22 as approved for construction to make up the total of 695 grade-crossing-eliminating structures included in the Public Works highway program up to the end of the year.

The number of projects of this character included in the program is evidence of the importance attributed to the elimination of accident hazards in preparing the program of work. In addition to the grade crossings eliminated by structures, many more have been avoided by relocation of the highways as part of the improvement to be made; and the ends of safety are also served by the widening of existing surfaces, the easing of curves and grades, the lengthening of sight distances, and other marked betterments that result from the improvements planned and in course of realization.

Other major objectives to which, subject always to the primary employment purpose, special effort has been directed include the closing of the remaining unimproved gaps in the Federal-aid highway system; and the provision of road facilities to aid in the better coordination of transportation, especially roads to local railroad stations and roads that will be capable of taking over the service heretofore rendered by nonpaying railroad branch lines.

Landscaping of a reasonable mileage of roadsides was one of the special objects sought in planning the program and the States were required to use at least 0.5 percent of the 1934 funds and 1 percent of the 1935 funds for this purpose. The total program—completed, under improvement, and planned—has included 582 roadside-improvement projects. These projects involve 1,831 miles that have or are to be improved at an average estimated cost of \$1,654 per mile. The majority of these projects are located on main arteries of travel at the approaches to the more important communities. Experience with this work has been valuable in developing proper methods of treatment and a trained personnel to supervise future work.

## CONSTRUCTION OF ROADS THROUGH PUBLIC LANDS AND FEDERAL RESERVATIONS

Special appropriations for the survey, construction, reconstruction, and maintenance of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, and other Federal reservations except national forests have been made by five congressional acts passed up to the end of the fiscal year 1935.

As reported last year, the first two of these appropriations, aggregating \$5,000,000, were made by the Emergency Employment Act of December 20, 1930, and the Emergency Relief and Construction Act of 1932. To this sum the National Industrial Recovery Act added \$5,000,000, the act approved June 19, 1934, \$2,500,000, and the Hayden-Cartwright Act \$2,500,000 for each of the fiscal years 1936 and 1937.

Of the total of \$17,500,000 authorized, \$10,000,000 was apportioned in prior fiscal years, \$2,500,000 was apportioned on July 5, 1934, and \$2,500,000 for the fiscal year 1936 was apportioned on June 4, 1935. Funds for 1937 have not been apportioned. A deduction of \$125,000 for administrative purposes was made from the first \$5,000,000 only. The States benefiting and the amounts of their apportionments are shown in table 23. The same table also shows the progress made toward expenditure of the funds in the several States. The size of the unobligated balance at the end of the fiscal year results from the new apportionment made on June 4.



TABLE 23.—*Status of appropriations for roads through public lands and Federal reservations, June 30, 1935*

State	Total sum apportioned	Sums allotted to projects—				Total allotted	Unobligated balance
		Not yet under construction	Under construction	Completed and finally inspected	Completed and final payment made		
Arizona.....	\$2, 174, 530	\$183, 952.84	\$191, 912. 10	\$447, 992. 83	\$987, 490. 47	\$1, 811, 348. 24	\$363, 181. 76
California.....	1, 380, 414	46, 043. 01	293, 363. 73	.....	586, 362. 23	925, 768. 97	454, 645. 03
Colorado.....	562, 610	.....	231, 884. 04	176, 751. 00	52, 956. 96	461, 592. 00	101, 018. 00
Idaho.....	805, 790	.....	78, 787. 70	133, 745. 89	435, 601. 72	648, 135. 31	157, 654. 69
Montana.....	806, 760	.....	137, 901. 00	.....	530, 411. 00	668, 312. 00	138, 448. 00
Nevada.....	3, 254, 815	19, 209. 80	507, 216. 30	582, 700. 79	1, 554, 040. 14	2, 663, 167. 03	591, 647. 97
New Mexico.....	1, 202, 724	.....	2, 645. 81	375, 034. 86	408, 663. 19	786, 343. 86	416, 380. 14
North Dakota.....	152, 605	.....	26, 941. 57	26, 237. 63	33, 606. 04	86, 785. 24	65, 819. 76
Oklahoma.....	150, 475	.....	23, 053. 96	19, 811. 02	84, 448. 02	127, 313. 00	23, 162. 00
Oregon.....	1, 004, 415	.....	188, 329. 87	.....	640, 754. 13	820, 084. 00	174, 331. 00
South Dakota.....	295, 206	.....	133, 010. 00	.....	65, 715. 00	198, 725. 00	96, 481. 00
Utah.....	1, 648, 991	35, 000. 00	244, 880. 55	110, 000. 00	969, 114. 45	1, 358, 995. 00	289, 906. 00
Washington.....	228, 593	.....	52, 420. 20	.....	134, 032. 80	186, 453. 00	42, 140. 00
Wyoming.....	1, 207, 162	.....	117, 101. 00	.....	833, 111. 53	950, 212. 53	256, 949. 47
Total.....	14, 875, 000	284, 205. 65	2, 230, 447. 83	1, 872, 274. 02	7, 316, 307. 68	11, 703, 235. 18	3, 171, 764. 82

## RESTORATION OF FLOOD-DAMAGED ROADS

No addition has been made during the past year to the appropriations previously made for relief of States on account of damage to roads by floods. The Hayden-Cartwright Act authorized the Secretary of Agriculture to expend for that purpose not to exceed \$10,000,000 of available funds in any emergency that might arise.

Of the various appropriations, those made to Vermont and New Hampshire and reported as expended in the last annual report are still the only ones completely expended. Of the appropriation to Kentucky, nearly \$127,000 was paid during the year, and the unobligated balance was reduced by about \$185,000.

In Missouri all available funds have been assigned to projects, and additional funds have been assigned to projects in Louisiana. There was no change in the status of the appropriations to Arkansas and Mississippi. The appropriations to these four States have no definite time of availability. Of the remaining appropriations, Florida's is unaltered in status since the previous year's report, and the availability of Alabama's unobligated balance of \$1,137,416 lapsed on June 30, 1935. The status of these several appropriations on June 30, 1935, is shown in table 24.

TABLE 24.—*Flood relief appropriated, amounts paid to States, and the unobligated balance of the appropriation on June 30, 1935*

State	Appropriated	Paid to States	Unobligated balance
Vermont.....	\$2, 654, 000. 00	\$2, 654, 000. 00	-----
New Hampshire.....	653, 300. 00	653, 300. 00	-----
Kentucky.....	1, 889, 994. 00	1, 361, 185. 71	\$444, 415. 39
Total.....	5, 197, 294. 00	4, 668, 485. 71	444, 415. 39
Arkansas.....	1, 800, 000. 00	1, 477, 693. 56	322, 306. 44
Louisiana.....	967, 582. 00	786, 271. 13	115, 390. 36
Mississippi.....	628, 000. 00	345, 266. 57	282, 733. 43
Missouri.....	258, 418. 00	119, 428. 31	-----
Total.....	3, 654, 000. 00	2, 728, 659. 57	720, 430. 23
Alabama.....	<sup>1</sup> 1, 618, 500. 00	481, 083. 81	<sup>2</sup> 1, 137, 416. 19
Georgia.....	<sup>1</sup> 505, 167. 50	465, 228. 21	<sup>3</sup> 20, 835. 35
South Carolina.....	<sup>1</sup> 801, 361. 00	799, 161. 00	-----
Florida.....	80, 307. 00	77, 296. 48	-----
Total.....	3, 005, 335. 50	1, 822, 769. 50	1, 158, 251. 54
Grand total.....	11, 856, 629. 50	9, 219, 914. 78	2, 323, 097. 16

<sup>1</sup> Does not include fund allowable for administration.<sup>2</sup> Availability for obligation expired June 30, 1935.<sup>3</sup> Availability for obligation expired June 30, 1934.

The mileage of road improved under the flood-relief acts up to the end of the fiscal year and the corresponding total cost and Federal payment are given in table 25. Similar information for roads completed and paid for during the past year is presented in table 26, and for roads under construction and approved for construction in table 27.

TABLE 25.—*Total cost, flood relief, and mileage improved to June 30, 1935*

State	Total cost	Flood relief	Miles
Vermont.....	\$5,651,965.83	\$2,654,000.00	61.2
New Hampshire.....	1,408,479.45	653,300.00	29.1
Kentucky.....	3,155,028.01	1,295,097.04	222.2
Total.....	10,215,473.29	4,602,397.04	312.5
Arkansas.....	843,914.04	405,711.21	49.8
Mississippi.....	11,433.59	3,563.66	.3
Total.....	855,347.63	409,274.87	50.1
Alabama.....	319,797.49	155,615.15	41.7
Georgia.....	414,095.59	199,950.06	5.1
South Carolina.....	1,737,926.92	801,361.00	22.3
Total.....	2,471,820.00	1,156,926.21	69.1
Grand total.....	13,542,640.92	6,168,598.12	431.7

TABLE 26.—*Total cost, flood relief, and mileage of roads which were completed and paid for during the fiscal year 1935*

State	Total cost	Flood relief	Miles		
			Initial	Stage	Total
Kentucky.....	\$203,260.45	\$81,613.09	12.9	14.8	27.7
Georgia.....	18,653.74	8,873.83	.4	-----	.4
South Carolina.....	345,492.21	163,939.02	3.9	-----	3.9
Total.....	364,145.95	172,812.85	4.3	-----	4.3
Grand total.....	567,406.40	254,425.94	17.2	14.8	32.0

TABLE 27.—*Total cost, flood relief, and mileage of roads finally inspected, under construction and approved for construction on June 30, 1935*

State	Total cost	Flood relief	Miles		
			Initial	Stage	Total
Kentucky.....	\$367,728.80	\$159,281.57	25.3	6.2	31.5
Louisiana.....	131,841.02	65,920.51	10.5	-----	10.5
Missouri.....	291,568.03	130,865.95	3.0	6.3	9.3
Total.....	423,409.05	196,786.46	13.5	6.3	19.8
Georgia.....	70,249.18	31,178.18	.8	-----	.8
South Carolina.....	68,092.45	29,800.00	.2	-----	.2
Total.....	138,341.63	60,978.18	1.0	-----	1.0
Grand total.....	929,479.48	417,046.21	39.8	12.5	52.3

The mileage of the several surface types represented in flood-relief roads completed and fully paid for during the fiscal year 1935 is given in table 28, and the total mileages completed, and under construction or approved for construction at the close of the fiscal year are given in tables 29 and 30, respectively.

TABLE 28.—*Mileage of various types of flood-relief roads completed and paid for during the fiscal year 1935*

State	Graded and drained	Sand-clay untreated	Gravel untreated	Bridges and approaches	Total		
					Initial	Stage	Total
Kentucky.....	4.0	-----	23.6	0.1	12.9	14.8	27.7
Georgia.....	-----	0.4	-----	-----	.4	-----	.4
South Carolina.....	2.9	.3	-----	.7	3.9	-----	3.9
Total.....	2.9	.7	-----	.7	4.3	-----	4.3
Grand total.....	6.9	.7	23.6	.8	17.2	14.8	32.0

TABLE 29.—*Mileage of the various types of flood-relief roads improved to June 30, 1935*

State	Graded and drained	Sand-clay untreated	Gravel, untreated	Gravel, surface treated	Macadam, surface treated	Bituminous macadam	Portland-cement concrete	Bridges and approaches	Total
Vermont.....	-----	-----	7.0	9.2	-----	6.1	32.5	6.4	61.2
New Hampshire.....	-----	-----	-----	2.9	4.9	2.3	18.4	.6	29.1
Kentucky.....	207.0	-----	13.6	-----	-----	-----	-----	1.6	222.2
Total.....	207.0	-----	20.6	12.1	4.9	8.4	50.9	8.6	312.5
Arkansas.....	16.1	-----	31.1	-----	-----	-----	.3	2.3	49.8
Mississippi.....	-----	-----	-----	-----	-----	-----	.3	-----	.3
Total.....	16.1	-----	31.1	-----	-----	-----	.6	2.3	50.1
Alabama.....	17.4	15.9	7.6	-----	-----	-----	-----	.8	41.7
Georgia.....	-----	.4	-----	-----	3.3	-----	.6	.8	5.1
South Carolina.....	12.9	.3	-----	-----	-----	-----	5.3	3.8	22.3
Total.....	30.3	16.6	7.6	-----	3.3	-----	5.9	5.4	69.1
Grand total.....	253.4	16.6	59.3	12.1	8.2	8.4	57.4	16.3	431.7

TABLE 30.—*Mileage of the various types of flood-relief roads finally inspected, under construction and approved for construction on June 30, 1935*

State	Graded and drained	Untreated gravel	Treated macadam	Portland-cement concrete	Bridges and approaches	Total		
						Initial	Stage	Total
Kentucky.....	25.1	6.2	-----	-----	0.2	25.3	6.2	31.5
Louisiana.....	-----	10.5	-----	-----	-----	10.5	-----	10.5
Missouri.....	-----	6.6	-----	2.4	.3	3.0	6.3	9.3
Total.....	-----	17.1	-----	2.4	.3	13.5	6.3	19.8
Georgia.....	-----	-----	0.3	.4	.1	.8	-----	.8
South Carolina.....	.1	-----	-----	-----	.1	.2	-----	.2
Total.....	.1	-----	.3	.4	.2	1.0	-----	1.0
Grand total.....	25.2	23.3	.3	2.8	.7	39.8	12.5	52.3



## WORK-RELIEF HIGHWAY PROJECTS

Work-relief highway projects, begun in the fall of 1933 to relieve distress in particular areas stricken by drought and a scourge of grasshoppers, became even more important in the fall and winter of 1934 when the effect of the drought on the rural population reached its peak. In the worst stricken areas road work was carried on by an arrangement under which the Public Works Administration granted amounts necessary to pay costs of materials and equipment, limited to not more than 30 percent of the total expenditure, and the Federal Emergency Relief Administration supplied from its relief rolls and paid the necessary workers.

Under this arrangement the Bureau of Public Roads, cooperating with the respective State highway departments, assumed the responsibility of supervising the road work.

Work of this sort has been carried on in 10 States on 8,727 miles of road. The number of projects in each State, the estimated cost and amount payable from Public Works funds, and the mileage of road involved are given in table 31.

TABLE 31.—*Number and estimated cost and mileage of National recovery work-relief projects undertaken to June 30, 1935, and Public Works funds involved*

State	Projects	Estimated total cost	Public Works funds	Mileage
	<i>Number</i>	<i>Dollars</i>	<i>Dollars</i>	<i>Miles</i>
Colorado.....	3	600,000.00	180,000.00	173.5
Florida.....	1	1,000,000.00	300,000.00	( <sup>1</sup> )
Kansas.....	18	2,100,000.00	630,000.00	611.8
Minnesota.....	39	3,221,200.11	786,937.44	566.6
New Mexico.....	6	970,000.00	291,000.00	309.9
North Dakota.....	42	3,457,742.65	900,000.00	1,421.2
Oklahoma.....	6	1,900,000.00	570,000.00	442.7
South Dakota.....	55	4,036,055.45	990,000.00	1,873.7
Texas.....	64	8,180,437.20	2,454,131.07	1,170.8
Wisconsin.....	44	4,448,020.47	883,418.44	2,156.6
Total.....	278	29,913,455.88	7,985,486.95	8,726.8

<sup>1</sup> Repairs to roads and bridges damaged by floods.

## LOAN-AND-GRANT HIGHWAY PROJECTS

Under the provisions of section 203 of the National Industrial Recovery Act, the Public Works Administration continued the policy adopted in the preceding year of financing or aiding, by loans or grants or both, in the financing of the construction of roads in a number of States. The road-building activity thus provided for was additional to all other projects initiated under the grants specifically authorized for highway construction by sections 204 and 205 of the act.

The detailed administration of this work was transferred to the Bureau of Public Roads by the Public Works Administration in 1934, and by the end of the fiscal year 1935 allotments amounting to over \$33,000,000 were under supervision. The status of the work is given in table 32.

TABLE 32.—Status on June 30, 1935, of loan-and-grant Public Works projects transferred by the Public Works Administration to the Bureau of Public Roads for supervision and audit

State	Funds allotted by Public Works Administration			Mileage, estimated cost, and funds assigned to specific projects approved under Public Works Administration allotments				
	Tentative allotment by Special Board for Public Works	Allotment by contracts executed		Miles	Estimated total cost	Funds assigned		
		Grant	Loan			Grant	Loan	Other
Alabama	\$72,200.00	\$19,700.00	\$52,500.00	6.4	\$62,882.00	\$18,471.58	\$44,410.42	\$3,222,918.31
California	1,510,300.00	1,510,300.00		14.0	4,462,635.11	1,239,716.80		3,598,081.67
Connecticut	2,387,700.00	2,387,700.00		68.1	7,499,137.80	2,246,778.05		5,555,515.42
Illinois	2,386,700.00	2,386,700.00		34.5	7,499,137.80	2,246,778.05		5,555,515.42
Indiana	204,300.00	204,300.00		34.5	752,308.36	166,792.94		509,713.28
Iowa	336,109.73	336,109.73		71.5	805,446.52	255,703.21		509,713.28
Kansas	5,122,353.96	1,529,803.96	3,592,000.00	36.1	4,132,152.23	1,227,802.40	2,581,278.12	323,071.71
Louisiana	5,005,300.00	1,511,600.00	3,533,700.00	47.4	3,016,099.66	90,482.89	2,111,126.77	
Maryland	5,411,866.00	1,411,866.00	4,000,000.00	72.2	5,121,662.71	1,411,040.39	3,578,581.20	3,906,079.25
Massachusetts	1,608,987.99	1,608,987.99		105.1	5,484,222.19	1,578,142.94		294,818.00
Michigan	10,000.00	10,000.00		29.0	39,818.00	10,000.00		241,888.63
Minnesota	2,981,022.04	981,022.04	2,000,000.00	463.9	2,428,806.51	707,288.95	1,490,628.93	
Mississippi	531,000.00	131,000.00	400,000.00	55.0	2,331,375.88	99,412.75	231,963.13	1,570,820.37
Missouri	1,026,000.00	1,500,000.00		49.6	2,188,717.45	608,897.08		276,625.21
Montana	1,829,000.00	579,000.00	1,250,000.00	697.4	1,984,510.06	482,500.36	1,225,376.49	28,620.22
Nebraska	11,500.00	11,500.00		59.5	40,120.22	11,500.00		622,002.88
New York	1,490,700.00	1,161,799.90	2,170,833.10	30.9	1,550,572.65	440,550.94	488,018.83	167,225.73
Ohio	87,902.77	87,902.77		11.8	237,026.20	69,800.47		
South Carolina	98,000.00	29,000.00	69,000.00	28.0	63,888.00	19,166.40	44,721.60	1,654,521.57
Texas	2,026,333.31	1,142,793.31	893,540.00	213.9	3,044,736.92	806,924.15	493,291.20	4,101,242.46
Washington	2,340,894.13	2,140,894.13		813.5	5,636,881.20	1,535,638.74		3,274,671.73
West Virginia	2,000,000.00	2,000,000.00		312.9	4,649,173.77	1,374,502.04		49,289.03
Wisconsin	454,800.00	148,550.00	306,250.00	119.5	398,554.65	116,889.65	282,375.97	
Total	33,143,174.66	20,167,774.56	15,412,983.10	4,399.9	55,856,723.71	15,640,414.71	10,630,775.66	29,585,533.34

<sup>1</sup> Grant to be increased \$550.  
<sup>2</sup> Grant to be reduced \$174,000.

<sup>3</sup> Loan and grant to be reduced \$1,842,033.  
<sup>4</sup> Grant to be increased \$2,800.

<sup>5</sup> Loan to be canceled, \$825,000.  
<sup>6</sup> Grant to be increased \$200,100.

## NATIONAL FOREST ROAD CONSTRUCTION

The two principal classes of forest roads are designated, respectively, forest highways and forest development roads. The latter, as the name implies, serve primarily for the development of the forests; the former are roads of a higher order of traffic importance, generally those joining sections of the Federal-aid or State highway systems outside of the forests, or important community-service roads requiring improvement generally more expensive than that required on forest development roads.

In the main, the work supervised by the Bureau of Public Roads is limited to the construction of forest highways; forest-development road work is generally administered by the Forest Service. But, while this definition of the work of the two Bureaus is approximately correct, the exact line of separation is drawn between what are termed major and minor projects. Major projects administered by the Bureau of Public Roads include all projects in the forest highway system except those that do not require the technical services of a highway engineering organization or those having an estimated average cost of less than \$2,000 per mile. Those forest development road projects of estimated average cost greater than \$5,000 per mile and those requiring technical services are also classed as major projects.

Work conducted during the past year has been done partly with funds remaining at the beginning of the year from the allocations made during the preceding year by the Public Works Administration, of \$15,000,000 for forest highways, and \$10,000,000 for forest development roads. These allocations were made under authority of the National Industrial Recovery Act. In December 1934 the forest highway funds were reduced by withdrawal of \$400,000 to be used for other road purposes. At the beginning of the year additional funds became available through the Hayden-Cartwright Act, which authorized an appropriation of \$24,000,000 for the various classes of road work in federally controlled areas. Of this amount, the allotment for forest highways was \$7,000,000 and that for forest development roads \$3,000,000. Similar amounts have been made available under the Hayden-Cartwright Act for the fiscal year 1936.

In accordance with requirements of the governing rules and regulations a system of forest highways has been designated by concurrent action of the several State highway departments, the Forest Service, and this Bureau, and approved by the Secretary of Agriculture. Also, as required by the rules and regulations, the highways constituting this system have been classified as follows:

Class 1. Forest roads forming sections of the Federal-aid highway system, either wholly within or, when so designated by the Forester and the Chief of the Bureau of Public Roads, partly without and adjacent to the national forests.

Class 2. Forest roads, not of class 1, which are parts of approved State highway systems, when so designated by the Forester and the Chief of the Bureau of Public Roads.

Class 3. All other forest roads, of primary importance to counties or communities.

The roads which, according to these definitions, had been classified as forest highways, had an aggregate length on June 30, 1935, of 17,363 miles, classified as shown in table 33.

TABLE 33.—*Classification of the mileage of the forest highway system as revised to June 30, 1935*

State	Mileage of forest highway system			
	Class 1	Class 2	Class 3	Total
Western:				
Alaska.....			484.9	484.9
Arizona.....	327.8	245.0	495.9	1,068.7
California.....	584.0	1,344.5	531.5	2,460.0
Colorado.....	511.0	1,166.0	75.0	1,753.0
Idaho.....	722.2	176.6	184.5	1,083.3
Montana.....	628.3	335.8	240.0	1,204.1
Nevada.....	104.8	206.1	148.3	459.2
New Mexico.....	164.0	518.0		682.0
Oregon.....	720.8	324.5	318.6	1,363.9
South Dakota.....	227.0		86.0	313.0
Utah.....	96.6	536.3	110.2	743.1
Washington.....	386.5	135.4	247.9	769.8
Wyoming.....	387.3	87.0	217.7	642.0
Total.....	4,800.3	5,025.2	3,141.5	13,027.0



TABLE 33.—*Classification of the mileage of the forest highway system as revised to June 30, 1935—Continued*

State	Mileage of forest highway system			
	Class 1	Class 2	Class 3	Total
Eastern:				
Alabama.....	4.0		31.0	35.0
Arkansas.....	192.3	144.3	90.5	427.1
Florida.....	39.7	135.0	36.3	211.0
Georgia.....	41.8	37.5	68.7	148.0
Illinois.....			24.0	24.0
Kentucky.....	41.0	58.0	13.0	112.0
Louisiana.....	48.3	118.7	38.0	205.0
Maine.....			11.0	11.0
Michigan.....	49.9	108.5	150.3	308.7
Minnesota.....	89.5	89.1	133.1	311.7
Mississippi.....	32.0	13.0	78.0	123.0
Missouri.....			5.0	5.0
Nebraska.....			28.8	28.8
New Hampshire.....	41.5	60.5	49.0	151.0
North Carolina.....	102.0	105.3	48.3	255.6
Oklahoma.....	31.5		70.5	102.0
Pennsylvania.....	134.0	250.9	39.0	423.9
Puerto Rico.....			21.0	21.0
South Carolina.....		26.0	11.0	37.0
Tennessee.....	83.8	105.0	79.0	267.8
Texas.....			21.0	21.0
Vermont.....	7.0		12.0	19.0
Virginia.....	79.0	127.9	210.0	416.9
West Virginia.....	137.0	182.0	62.0	381.0
Wisconsin.....	5.0	148.9	136.1	290.0
Total.....	1,159.3	1,710.6	1,466.6	4,336.5
Grand total.....	6,019.6	6,735.8	4,608.1	17,363.5

During the past year improvements were completed on 1,232 miles of the forest highway system, bringing the total mileage improved to date with Federal funds to 6,231 miles. Of the mileage improved during the year, 1,150 miles were in the Western States and Alaska, and the remaining 82 miles were in the forests of 16 Eastern States. Of the total mileage improved to date, 5,706 miles are in the West, and 525 miles are in the East.

The mileage of forest highway projects completed during the year and to date by States is shown in table 34.

TABLE 34.—*Mileage of completed forest-highway projects, by States*

State	Mileage of forest-highway projects completed		State	Mileage of forest-highway projects completed	
	During 1935	Total to June 30, 1935		During 1935	Total to June 30, 1935
Western:			Eastern—Continued.		
Alaska.....	25.1	248.1	Florida.....	5.0	61.6
Arizona.....	119.2	526.5	Georgia.....		21.4
California.....	142.9	757.9	Illinois.....	1.5	1.5
Colorado.....	117.0	496.6	Michigan.....	20.5	38.9
Idaho.....	103.2	640.3	Minnesota.....	5.0	108.8
Montana.....	110.4	571.1	Nebraska.....		8.7
Nevada.....	34.2	152.9	New Hampshire.....		13.2
New Mexico.....	104.9	298.1	North Carolina.....	3.2	49.6
Oregon.....	171.8	970.1	Oklahoma.....	15.4	15.4
South Dakota.....	14.6	61.2	Pennsylvania.....	3.0	6.0
Utah.....	48.0	329.7	South Carolina.....		15.6
Washington.....	45.8	307.7	Tennessee.....		37.4
Wyoming.....	112.9	346.3	Virginia.....	5.2	21.0
Total.....	1,150.0	5,706.5	West Virginia.....	2.6	6.2
Eastern:			Total.....	82.2	524.7
Alabama.....		5.1	Grand total.....	1,232.2	6,231.2
Arkansas.....	12.1	114.3			

On June 30, 1935, work was in progress under the supervision of the Bureau of Public Roads on 738 miles of road at a total estimated cost of \$7,274,505. Work estimated to cost \$5,768,608 had been planned but not yet started; and there was a balance of authorized funds not yet obligated to definite projects amounting to \$2,786,021.

### ROAD CONSTRUCTION IN NATIONAL PARKS

During the fiscal year 1935 construction was completed on a total of 99 miles of roads in national parks, making a total of 930 miles thus far improved. Under an agreement of several years' standing construction of these roads is supervised by the Bureau of Public Roads.

The mileage constructed during the fiscal year and to date in the several parks is shown in table 35.

TABLE 35.—*Mileage of national-park roads improved under the supervision of the Bureau of Public Roads*

National park or monument	Completed during fiscal year 1935	Total completed to June 30, 1935	National park or monument	Completed during fiscal year 1935	Total completed to June 30, 1935
	Miles	Miles		Miles	Miles
Acadia.....	0.6	8.4	Morristown.....	1.7	1.7
Bryce Canyon.....	5.7	21.9	Mount Rainier.....	1.8	63.1
Carlsbad Caverns.....	8.4	8.4	National Capital Parks.....	1.1	1.8
Colonial National Monument.....	9.4	20.4	Petersburg.....	3.5	3.5
Crater Lake.....	4.2	45.8	Petrified Forest.....	0	26.3
Devil's Tower National Monument.....	0	.3	Rocky Mountain.....	4.2	43.1
General Grant.....	0	6.4	Scotts Bluff.....	0	.6
Glacier.....	1.3	55.7	Sequoia.....	3.4	42.7
Grand Canyon.....	3.3	154.4	Shenandoah.....	0	40.1
Great Smoky Mountains.....	0	4.0	Wind Cave.....	.6	15.9
Hawaii.....	10.7	35.6	Yellowstone.....	22.5	178.6
Lassen Volcanic.....	4.9	35.3	Yosemite.....	11.6	76.7
Mesa Verde.....	0	20.4	Zion.....	0	18.9
			Total.....	98.9	930.0

Bureau activities continued in all parks and monuments during the year. Nearly all of the newly acquired military parks, battlefields, and cemeteries have at least one project under construction, and some of the larger areas have considerable road construction under way.

In the Western States the Red Lodge-Cooke City National Park approach road to Yellowstone National Park and the Cameron-Desert View approach road to Grand Canyon National Park are practically completed. Both of these projects will be finished during the present construction season.

Carlsbad Caverns National Park road improvements show completed mileage for the first time. A project 8.4 miles in length was completed in that park during the past year.

The road program in Shenandoah National Park is progressing rapidly. Three sections of road aggregating approximately 30 miles between Front Royal and Panorama are at present under construction. The section between Panorama and Swift Run Gap was surfaced during the fiscal year and is being visited by tourists from many Eastern States.

On one section of the Shenandoah-Great Smoky Mountains Parkway, connecting Shenandoah National Park in Virginia with the Great Smoky Mountains National Park in North Carolina and Tennessee, construction is ready to begin, and plans and surveys have been completed for several other sections. The parkway will be about 450 miles long, 210 miles in Virginia and 240 miles in North Carolina. When completed, this road will extend along the crest of the Blue Ridge Mountains and will be a beautiful scenic drive.

The Green Mountain Parkway in Vermont and the Natchez Trace in Tennessee and Mississippi are two other large eastern projects that were being surveyed at the end of the year.

On June 30, 1935, over \$16,000,000 of road work had been placed under contract from funds provided by the National Industrial Recovery Act. Of this amount, approximately \$9,500,000 is involved in work under construction in the West and \$6,500,000 in the East. In addition to this amount, about \$2,300,000 of work has been begun under the Hayden-Cartwright Act, of which approximately \$1,800,000 represents work in the West and \$500,000 work in the East.

### INTER-AMERICAN HIGHWAY

A report on the proposed Inter-American highway was made by the Bureau in November 1934 and has been published as Senate Document No. 224. This report covers a reconnaissance survey of the proposed route through Panama and the republics of Central America, and includes detailed discussion of the engineering and economic considerations presented by this project. It is illustrated with photographs and numerous plan and profile maps.

In March 1935 the Bureau reopened the office at Panama City, Republic of Panama, that it had maintained with the cooperation of the Central Road Board of Panama during the reconnaissance-survey operations, and assigned to it a senior highway engineer and a senior economist. In May a field party began location surveys in the western portion of Panama, to fix the exact route that the highway will follow between Concepcion and the Costa Rican border. Construction of this section will complete the highway in Panama.

A representative of the Bureau visited the seven countries through which the highway will pass—Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, and Mexico—during the latter half of the fiscal year, and interviewed high government officials regarding their plans for developing the highway, particularly with reference to their cooperation with the United States Government in construction activities, for which the Congress in 1934 appropriated \$1,000,000.

### TRANSPORTATION, ECONOMIC, AND STATISTICAL INVESTIGATIONS

#### NEW JERSEY TRAFFIC SURVEY

A survey of traffic upon the entire State highway system of New Jersey and a limited mileage of county routes was completed and a report made to the State highway department. A digest of the report has been published in Public Roads. The report contains a traffic classification of all State highways and recommendations for pavement and right-of-way widths for the entire State system.

It was shown that each mile of the State highway system is used, on an average, by 4,659 vehicles a day, a fact which places the New Jersey system among the most intensely used highway systems in the country. A heavy traffic was found entering the State at Hudson River and Delaware River crossings, and 16.3 percent of this traffic was found to pass through New Jersey. In a special study of motor-truck traffic it was discovered that owner-operated trucks constituted 79 percent of truck traffic, contract-hauler trucks 17.7 percent, common-carrier trucks 2.2 percent, and Government-operated trucks 1.1 percent. Sixty-six out of each 100 trucks had both their origin and destination within the State. Seventy-two percent of owner-operated trucks were engaged in intrastate traffic, as compared with but 37 percent of contract haulers and 32 percent of common-carrier trucks. Manufactured products were carried by 56 percent of the loaded trucks, agricultural products by 20 percent, and 11 percent were engaged in retail delivery. Trucks up to  $1\frac{1}{2}$  tons capacity constituted 55.5 percent of the total number; those of capacities of from  $1\frac{1}{2}$  to 5 tons, 23.3 percent; and those of 5 tons capacity and over, 21.2 percent.

#### FLORIDA TRAFFIC SURVEY

A report of a survey of traffic upon the State highway system of Florida was submitted to the State road department and published by that department. A digest of the report was published by the Bureau. The report contained data for use in planning future highway improvements in the State and much information in regard to the amount and character of two of the most important highway movements—the tourist traffic and the movement of citrus fruits. Tourist expenditures in Florida were estimated to be approximately 90 million dollars



annually, one-third spent by those stopping in hotels and another third spent by home owners. Expenditures per party per day were found to vary from an average of \$8.81 per day for those stopping at hotels to the \$2.63 per day for camping parties. It was estimated that the fuel tax paid by tourists to the State of Florida amounts to about \$2,600,000 a year.

Fifteen percent of the 215,600 outgoing trucks crossing the Florida State line during the year carried citrus fruits. About 88 percent of the total interstate truck shipments of citrus fruit were shown to be destined to Georgia, South Carolina, Alabama, North Carolina, Tennessee, the District of Columbia, and Virginia. Georgia and South Carolina accounted for more than half the total.

#### CONNECTICUT TRAFFIC SURVEY

Field work on a survey of traffic in Connecticut terminated in October 1934, and the report is practically completed. As a special phase of this survey, the speed at which nearly 90,000 vehicles were traveling was determined by stop watch at 78 points on the rural highways. The average observed passenger-car speed slightly exceeded 40 miles per hour, while trucks averaged a little below 35 miles per hour. The effect of weather, road types, and other variables will be analyzed in a separate report.

#### ARKANSAS TRAFFIC SURVEY

Field work on a survey of traffic in Arkansas was completed in June 1935 and preparation of a report begun. This survey, conducted in cooperation with the State Highway Commission of Arkansas, will provide data on the usage of the entire State highway system and serve as a basis in planning future improvement.

#### TRAFFIC CAPACITY AND INTERSECTION STUDIES

Studies of the speed of vehicles in relation to traffic density and highway capacity have been initiated. Field observations conducted during the summer on a number of important highways of various types in the vicinity of Boston, Mass., provided detailed records of individual-vehicle speeds over a wide range of traffic volume. From these records effort will be made to determine the traffic capacity of highways, the effect of slow vehicles upon such capacity, and the range of speed under given circumstances of traffic density.

Studies of the effect of control methods on traffic delay at intersections have been continued during the year.

#### NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY

The Bureau continued its cooperation with the executive committee of the National Conference on Street and Highway Safety, particularly with regard to presenting and explaining the five acts of the Uniform Vehicle Code to legislative bodies and civic groups in various States. The progress being made in the adoption of this uniform legislation, which is one of the most important elements in the Nation-wide campaign to promote highway safety, is evidenced in table 36, showing the status of adoption to date of substantial parts of the code. The nine States and the District of Columbia in which legislation has been enacted in 1934 and 1935 are indicated by figures in parentheses.

TABLE 36.—*States with motor-vehicle laws containing substantial parts of the Uniform Vehicle Code, as of June 30, 1935*

Act 1, uniform motor-vehicle administration, registration, certificate of title, and antitheft act <sup>1</sup>	Act 2, uniform motor-vehicle operators' and chauffeurs' license act	Act 3, uniform motor-vehicle civil-liability act	Act 4, uniform motor-vehicle safety-responsibility act	Act 5, uniform act regulating traffic on highways <sup>2</sup>
Arizona California Colorado Delaware District of Columbia Florida Georgia Idaho Indiana Louisiana Maryland Michigan Missouri Montana Nevada New Mexico North Carolina North Dakota Oklahoma Oregon Pennsylvania South Dakota Utah Virginia West Virginia Wisconsin	Arizona California <sup>3</sup> Colorado Connecticut <sup>3</sup> Delaware <sup>3</sup> District of Columbia <sup>3</sup> Idaho (1935) <sup>3</sup> Indiana Iowa Kansas Kentucky (1934) Maine Maryland <sup>3</sup> Massachusetts <sup>3</sup> Michigan Minnesota Montana Nebraska Nevada New Hampshire <sup>3</sup> New Jersey <sup>3</sup> New York <sup>3</sup> North Carolina (1935) <sup>3</sup> North Dakota (1935) Oregon <sup>3</sup> Pennsylvania <sup>3</sup> Rhode Island <sup>3</sup> South Carolina Utah <sup>3</sup> Virginia <sup>3</sup> Vermont <sup>3</sup> Washington <sup>3</sup> West Virginia <sup>3</sup> Wisconsin	California Colorado Connecticut Delaware Idaho Illinois Indiana Iowa Kansas Massachusetts Michigan Minnesota Montana Nebraska New York Nevada North Dakota Ohio Oregon Pennsylvania Rhode Island South Dakota Texas Vermont Washington Wyoming	Arizona (1935) California Colorado (1935) Connecticut Delaware District of Columbia (1935) Indiana Iowa Maine Maryland Michigan Minnesota Nebraska New Hampshire New Jersey New York North Carolina North Dakota Ohio (1935) Oregon (1935) Pennsylvania Rhode Island South Dakota Vermont Virginia Wisconsin	Arizona California Colorado Delaware Idaho Louisiana Maine Michigan Minnesota Nebraska New Hampshire New Jersey New Mexico North Carolina North Dakota Oregon Pennsylvania South Dakota Utah Virginia Washington Wisconsin

<sup>1</sup> All States have some form of registration laws. The States listed in this column have laws conforming more closely to the provisions of act 1 of the code than do the other States.

<sup>2</sup> All States have some form of rules of the road and equipment requirement laws. The States listed in this column have laws conforming more closely to the provisions of act 5 of the code than do the other States.

<sup>3</sup> Has full standard licensing system, including examination of new drivers, suspension and revocation of licenses for cause, and a strong centralized administration. Other States listed have licensing laws, but for various reasons are not considered standard.

### STUDIES OF TAXATION

Reports on State finances, with special reference to highways, were completed for New Hampshire and Minnesota. Similar studies in New York, Colorado, Wyoming, and New Mexico, are nearing completion. These investigations are part of a series designed to establish the relation of highway taxes paid from different sources and by different groups of citizens to highway expenditures, and to lay down a broad basis for the adjustment of highway taxes on a rational plan.

### MOTOR-VEHICLE TAXATION IN 1932

Practically complete data on motor-vehicle taxation were made available for the first time in the report, Taxation of Motor Vehicles in 1932, published in October 1934. The detailed public charges borne by motor-vehicle owners are itemized in this report as to taxing jurisdictions, types of vehicles, and classes of taxes and fees. Total fees and taxes in 1932 are shown to have been \$1,001,150,000, of which approximately \$92,000,000 were accounted for by Federal manufacturers' excise taxes, \$839,000,000 by State fees and taxes, and the remainder by public bridge and ferry tolls, county and municipal fees and taxes, and personal-property taxes.

## RAILROAD LINE ABANDONMENT STUDIES

The arrangement made with the Interstate Commerce Commission and the American Railway Association, whereby the Bureau undertook to make studies of branch lines and sections of railroad that it was proposed to abandon, with a view to ascertaining the effect of such action on highway traffic in the immediate vicinity, was continued through the year. Thirty-six cases were studied, involving 1,042 miles that it was proposed to abandon, distributed among the States as shown in table 37.

TABLE 37.—*Sections of railroads that it was proposed to abandon inspected during fiscal year*

State	Projects	Railroad	Highways inspected	State	Projects	Railroad	Highways inspected
	Number	Miles	Miles		Number	Miles	Miles
Alabama.....	1	7.10	41	New York.....	2	54.50	121
Arkansas.....	1	26.40	54	North Dakota.....	1	11.10	15
Georgia.....	1	56.66	111	Pennsylvania.....	2	22.80	32
Indiana.....	2	69.69	104	South Carolina.....	1	76.50	125
Iowa.....	4	126.60	219	South Dakota.....	3	65.44	122
Kansas.....	2	59.73	72	Tennessee.....	3	71.63	182
Maine.....	1	36.00	86	Vermont.....	1	19.34	20
Maryland.....	1	25.63	54	West Virginia.....	1	19.97	30
Michigan.....	2	123.73	174	Wisconsin.....	1	8.91	27
Minnesota.....	1	17.50	57	Wyoming.....	1	44.73	87
Mississippi.....	2	41.59	134				
New Jersey.....	1	8.36	25	Total.....	36	1,041.93	1,955
New Mexico.....	1	48.02	63				

This work was done to determine which secondary or other roads should be built to serve communities now served by these railroads.

## MAINTENANCE COST STUDIES

Agreements were made in April 1935 with the State highway departments of Connecticut, New Hampshire, and Rhode Island to study highway-maintenance costs in relation to traffic volume. Field work was begun shortly thereafter by counting traffic on selected road sections that afford an adequate sample of all types of construction. Careful records will be kept of maintenance expenditures on these road sections.

## PAVEMENT LIFE STUDIES

A study of the actual service life of various types of highway and street pavement was begun in cooperation with the Iowa Engineering Experiment Station of Iowa State College. Records of State, county, and municipal highway departments are being studied to determine the age of pavements, including those in use and those that have been replaced, and to develop mortality curves for use in highway planning. Data have been collected on the highways of Wayne County, Mich.; the State trunk-line system of Michigan, the State roads of Massachusetts, Vermont, New Hampshire, Connecticut, and Rhode Island; and the street systems of Des Moines, Iowa, and Buffalo, N. Y.

## TRAFFIC SAFETY SURVEYS

In Rhode Island and South Carolina cooperative traffic-safety surveys were conducted during the year as white-collar relief projects. Volume and type of traffic, speed of vehicles, and obedience of drivers to traffic-control devices were recorded in the field, and the data were subsequently analyzed in detail. A report on the Rhode Island survey has been made to State authorities and that on the South Carolina survey is in preparation.

At the request of the Federal Emergency Relief Administration, the Bureau detailed a traffic engineer to advise with the local directors in preparing reports on traffic-safety surveys in the cities of Chattanooga, Knoxville, Memphis, and Nashville, Tenn. Field work on these surveys, begun under the Civil Works Administration, had been completed, but assistance was needed in the analysis and interpretation of the data. The completed reports include an analysis of accident data, traffic volume, the obedience to traffic-control devices and regulations, and recommendations for the improvement of street traffic conditions.



## HIGHWAY MANAGEMENT AND PRODUCTION COST STUDIES

## PRODUCTION ON RELIEF PROJECTS

During the past year requirements in the administration of the enlarged emergency highway program, especially those pertaining to the employment of labor, have necessitated new studies to determine more definitely the amount of labor provided by a given expenditure and how this varies with such factors as type of construction, methods of operation, region in which the work is located, and the season when performed. Such information is essential to the proper planning of road work for employment relief and prerequisite to formulating adequate means and methods for a material reduction of the present rather large seasonal fluctuations in highway employment.

These studies already have produced much definite data as to the practical value of highway work as a relief measure. For example, the expenditure for drought-relief road work in the 18 southwestern counties of Kansas to January 1, 1935, amounted to \$1,458,906. As a return for this expenditure the drought-stricken farmers were provided not only with employment sufficient to give a measure of support to themselves, their families, and their livestock, but their work had been utilized so effectively that their communities had been provided with substantial road improvements involving 409 miles of grading and 209 miles of surfacing with gravel and selected materials. The grading required the movement of 5,061,584 cubic yards of earth, and the surfacing involved the placing of 229,979 cubic yards of gravel and other selected materials.

The expenditures for this work were distributed as follows:		Percent
Labor.....	-----	54. 8
Teams.....	-----	18. 3
Trucks.....	-----	6. 0
Supervision.....	-----	3. 7
Materials.....	-----	9. 4
Engineering.....	-----	7. 8
Total.....	-----	100. 0

Both teams and trucks were hired almost entirely from the local farmers. Foremen and much of the help employed by the resident engineers and most of the materials were obtained locally. Consequently, a large part of every dollar expended served to provide immediate and direct local relief.

## EMPLOYMENT IN ROAD CONSTRUCTION

Studies have been continued of those types of highway construction in which mechanical equipment plays an important part to determine more definitely the returns that accrue to labor. On such work the expenditure for direct employment on the job may be as low as 14 to 20 percent of the daily cost. All available data, however, indicate that, in spite of this relatively small use of labor directly on the job, the proportion of the total expenditures that eventually reaches workers through more or less indirect channels is very large, seldom less than about 85 percent of the total cost of the improvement.

Studies have shown quite clearly that, on the average high-type road construction job, a large proportion of the primary expenditures for materials, transportation, equipment and supplies eventually accrues to labor. Materials require labor and equipment for their production and transportation. Supplies are used up and require labor and equipment for their production. Equipment wears out and requires labor for its repair and renewal. The benefits to labor and business by the construction of high-type road improvements are therefore not localized but widely diffused. These benefits are not confined simply to the immediate employees directly on the job but extend to such diverse industries, as rock quarries and sand pits, cement mills, asphalt and oil works, railroads, trucking and other transportation agencies, steel and lumber mills, powder works, coal and ore mines, and to all agencies that produce, transport, store, or deal in the many products required directly and indirectly in highway construction. A report resulting from these studies is being published.

Considerable time has been devoted to obtaining adequate records of the amount of employment provided by the current State and Federal highway-construction program. A monthly record is compiled of the number of persons employed in each State on work involving either State or Federal funds. Comparisons of the number of names on pay rolls with the size of the average working force indicate that the number of pay-roll names exceeds by 30 percent the

average number of individuals working throughout the pay-roll period. The percentage varies with the type of work. Weather, seasons of the year, efficiency of the job management, and industrial conditions appear to have an appreciable influence on the rate at which laborers change employment.

#### ESTIMATING STANDARDS

In estimating the cost of highway construction there is often considerable difference between the engineer's estimate and the bid of the low bidder. The estimates of the various bidders frequently cover a wide range. Highway engineers have need for more accurate methods of estimating costs as a basis for highway programs, and contractor's profits depend on the accuracy of their estimates.

Efforts have been made during the past year to develop standard forms, definitions, and subdivision of items that will permit the engineer and the contractor to prepare their estimates on a common basis. These proposed standards are now being tried on a number of jobs. Indications are that these standards, if generally adopted, will bring about a decided improvement in methods of estimating.

#### INDEX FIGURES

A study of highway-construction costs during the past 10 years for the country as a whole reveals wide variations in unit costs of labor and materials and a general downward cost trend. However, the reduced costs of the components have not been reflected directly in the cost per mile of highways constructed. More intense highway usage and public demand have brought about higher standards of construction, such as wider roadways, better alinement, reductions of grades, and general roadside beautification. This has tended to bring the cost per mile of highway construction to a more uniform level. Tables are in preparation which will show both cost and usage variations in terms of index numbers for the years 1927 to 1934.

#### UNIT COST AND PRODUCTION STUDIES

Administrative work in connection with the emergency highway program has made it necessary to curtail the usual unit cost and production studies during the past 2 years. Some phases of former studies have been completed and published. A limited amount of work is under way largely in connection with the development of improved standards for preparing cost estimates and determining the number of man-hours and equipment-hours involved in the numerous items of highway construction. More precise knowledge of the amount of human labor required in each road-building and maintenance operation and the extent to which the labor element varies with different methods and different kinds of equipment is an urgent need.

#### HIGHWAY ACCOUNTING METHODS

Efforts to further the development and installation of efficient accounting procedures by highway-building agencies have been continued. The Bureau has a direct interest in such procedures because of its cooperation with the States in road construction and also its service in supplying general information on highway income and expenditure and costs of construction and maintenance by types. Efficient statistical and accounting control is necessary for administrative reasons and also to provide the engineering organization with the proper means for determining costs and properly comparing the relative merits of new and old procedures, methods of operation, and types of organization. For accumulations of experience and data to be of the greatest possible value it is necessary that statistical methods, terms, and nomenclature be uniform so that the accomplishments of one State can be compared fairly with those of any other. As yet, such comparisons can be made only between a few States. The aim of the Bureau is to provide a system of accounts and records that will be economical in operation, will meet all of the accounting requirements of a State highway department, and provide quickly and in practical form complete statistical information on any desired activity in which the department is engaged, fully comparable with similar activities in any other State. Cooperative work of this type was continued during the year.



## PHYSICAL RESEARCH

### SUBSURFACE EXPLORATION

Subsurface exploration is a new line of research in which instruments and field technic for the location and identification of subsurface formations of rock and other materials of importance in highway work are being developed. This work was mentioned briefly in the last annual report. During the past year the two types of equipment being investigated, the resistivity apparatus and the seismic apparatus, have been given extensive field tests in Maryland, Virginia, and in the District of Columbia. Subsurface explorations have been made in connection with work of the Navy Department, the National Park Service, the Bureau of Mines, the bridge department of the District of Columbia, and the Bureau of Public Roads. In several places where subsequent excavation, test pits, or core borings permitted a comparison between the prediction made and the actual depth to rock the agreement was close. A description of the apparatus and its use has been published by the Bureau in Public Roads.

### INVESTIGATION OF CONCRETE-PAVEMENT DESIGN

A major investigation relating to concrete-pavement design and information about the structural action of concrete pavements, is nearing completion. The investigation has been divided into four principal parts: (1) A study of the effects of temperature and of moisture on the structural action of concrete pavements; (2) the development of basic information on the design of slab cross sections; (3) a comparative study of the structural action of a number of typical joint designs under the action of applied loads; and (4) an experimental study of the Westergaard method of analysis of stresses in pavement slabs.

Most of the field work has been completed, and reports have been drawn up describing the project and giving the final results of the first two parts. Similar reports covering the last two parts are in preparation. These reports will provide reliable information on the structural action of concrete pavements and should aid in securing more economical pavement design.

### MOTOR-VEHICLE IMPACT INVESTIGATIONS

The study of the elastic properties of concrete under static and impact forces is the present active research in the general field of motor-vehicle impact. In order to use the information previously developed by the Bureau about motor-vehicle impact, a study is being made of the effect on pavements of impact forces as compared with statically applied forces. The development of test apparatus for these studies has been a difficult problem, but it is thought that the instrumental difficulties have been overcome. Testing already completed indicates that the present equipment is satisfactory.

### MEASUREMENT OF ROAD SURFACE ROUGHNESS

The use of a roughness indicator mounted on a standardized, single-wheel vehicle has already been reported. Damping the free period of oscillation of such a vehicle was found necessary. It is believed that satisfactory spring damping has been obtained with specially designed hydraulic damping devices. The complete surface-roughness measuring apparatus is being tested on roads of various degrees of roughness and under as wide a range of temperature as possible in order to determine its limitations.

### HIGHWAY BRIDGE INVESTIGATIONS

The tests to determine the friction developed in the sliding expansion bearings in highway bridges, mentioned in last year's report as practically completed, have been finished. Certain additional tests suggested by the results of the original investigation have also been made. The complete results of the entire investigation are included in a nearly completed report.

### INVESTIGATION OF CORRUGATED METAL CULVERTS

The investigation of corrugated metal culverts is primarily a study of an erosion test for bituminous-coated corrugated-metal culvert pipe. This erosion test has been developed in Connecticut, and is proposed by that State as a criterion for the acceptance of metal culvert pipe coated internally with asphalt. The Bureau study includes the test and specification as proposed and also the



effect of some of the variables involved. A testing machine has been built and arrangements made with three other agencies for a series of check tests to determine how closely various laboratories can be expected to check each other in making the present test.

#### THE STUDY OF FLEXIBLE TYPES OF HIGHWAY SURFACES

The Bureau has begun a systematic attack on another important problem. A study is being made of the manner in which flexible types of road surfacing act in supporting traffic loads. New information is sought with which to rationalize methods of determining the thickness of flexible pavements. This problem is complex, but its importance warrants thorough and painstaking study.

#### NONBITUMINOUS ROAD MATERIALS

The investigation of the effect of chemical composition of portland cement on the durability of concrete, started last year, is being continued. A number of cements of widely varying composition, in combination with sands of good and poor quality, are being subjected to an accelerated weathering test. The effect of varying the proportion of cement to sand as well as the effect of the length of the initial curing period prior to the weathering test are being studied. Although the investigation is incomplete, certain indications as to the comparative importance of the variables are: (1) That variations in the quantity of cement used, as controlled by variations in the water-cement ratio, are of greatest importance so far as durability is concerned; (2) that the effect of quality of sand is more pronounced in lean mixtures than in rich mixtures; and (3) that variations in the chemical composition of the cement are of minor importance as compared with the other two variables.

During the year considerable attention was given to the development of a suitable test for quality of coarse aggregates. Additional work on the Los Angeles abrasion test, referred to in the report of last year, has been reported. In this paper the results of tests on samples representing a large number of sources of crushed stone, gravel, and slag are given in conjunction with the service records of these materials in bituminous road construction. The satisfactory agreement between results in the Los Angeles test and service behavior indicates that this test meets the need that has existed for a more determinative test for the quality of aggregates.

A preliminary study of the results of tests to determine the effect of vibrating concrete placed in pavement slabs shows approximately the same results as were obtained in the tests reported in 1933. A detailed study is being made of the large volume of data.

During the past year concrete pavements were investigated in Alabama, Georgia, Mississippi, South Carolina, and Tennessee. Pavements built prior to 1930 were inspected for evidence of disintegration, and a record was made of the amount and degree of the disintegration found. Information was obtained as to the materials used in construction and the construction practices followed. These data are being analyzed in an effort to discover the causes of disintegration. The study of the many factors to be considered has not been completed, and no final conclusions have been drawn.

Work has been begun on a series of laboratory tests to determine the effect of "de-airing" on the quality of vitrified paving brick. De-airing is an improvement in manufacturing technic recently introduced. The process involves subjecting the clay to a high vacuum to remove air and thus increase the density of the brick.

The project is being carried on in cooperation with the National Paving Brick Manufacturers Association, and a parallel series of tests sponsored by the association is under way in the laboratory of the Ohio Engineering Experiment Station. Direct comparisons will be made between the quality of the de-aired brick now being manufactured in plants located in Pennsylvania, Ohio, Indiana, and Illinois, and the quality of brick from the same plants manufactured by the old process. Samples of light-burned, medium-burned, and hard-burned brick manufactured by each process are being subjected to several tests, including the standard rattler, compression, and flexure tests. Other special tests are designed to reveal improvements in quality effected by the new process.

#### BITUMINOUS ROAD MATERIALS

Research on bituminous materials and their uses in road construction has continued along the general lines followed in previous years. It has included laboratory examination of bituminous materials and aggregates, field studies

of problems in bituminous construction, and a continuation of the cooperative work with State highway departments and the asphalt industry in connection with the standardization of specifications and test methods for liquid asphaltic road materials.

Laboratory studies of the properties of asphalt cements, tars, emulsions, and other liquid asphaltic materials are in progress, seeking to provide new information about their physical and chemical properties, to determine the value of the commonly specified tests as indicators of probable service behavior, and to determine those properties that are indicative of quality in order that the requirements necessary for given conditions may be specified without reference to the source of the material or its method of manufacture. The materials studied are representative of the present production fields and of the products manufactured.

Progress reports on the work done on tars, emulsions, and liquid asphaltic materials are in preparation. The study of asphaltic cements begun recently was prompted by the growing tendency to include in specifications requirements of questionable value in the control of quality, which tend to restrict unduly the field of supply.

Variations in refinery practice, resulting from unbalanced demand for certain petroleum products, have resulted in the production of bituminous materials that show variation in service behavior that cannot be predicted from the results of present tests. It has become extremely important to devise tests or combinations of tests that will definitely indicate quality and probable service behavior.

Laboratory studies are being continued on bituminous mixtures of the hot and cold types to determine the factors governing service behavior. The study of the hot mixtures is a continuation of former work to develop suitable tests and test methods. The study includes cooperative work with the California Department of Public Works on mixtures of known behavior.

Mixtures of the low-cost type in which liquid bituminous materials are used are being tested on the small circular tracks, mentioned in previous reports. The tests are expected to yield information on resistance to weathering and the effect of such factors as the amount of moisture, the kind, quantity, and viscosity of bitumen, and the type and grading of aggregates. Reports on the completed phases of these studies are in preparation.

Studies of two experimental roads in cooperation with State highway departments were continued during the year but were discontinued at its close. These projects are in South Carolina and Nebraska. In South Carolina bituminous surfaces of several types constructed on sand-clay and marl bases were studied. In Nebraska poorly graded sand, known as "blow sand", combined with medium- and slow-curing asphaltic materials in the road-mix type of construction was investigated. The sand used in this project is typical of that found in a large area containing no other aggregate suitable for bituminous construction. Final reports on these two projects are being prepared.

Field studies of a number of low-cost types of bituminous construction were made during the year to obtain information on particular types of construction. Such studies included the penetration macadam built extensively in Pennsylvania during the last few years, the open-type, plant, and road-mix construction built extensively in Alabama on chert and other bases, and in Oklahoma on relatively thin bases constructed on soils of low capillarity.

Work in cooperation with the State highway departments and the asphalt industry to standardize specifications for liquid asphaltic road materials has been continued. During the past year regional meetings were held to discuss the results obtained with the tentative standard specifications previously proposed and to consider necessary modifications. This work will be continued.

#### SUBGRADE INVESTIGATIONS

Increasing interest in the use of information about subgrade soils has been shown by various State highway departments, and a number of them have established soil-testing laboratories. The Bureau has prepared a series of check samples that are sent to these laboratories on request for the purpose of standardizing the testing procedure. Procedures for the more commonly used tests have been prepared. These procedures have been adopted by the American Association of State Highway Officials and are being considered by the American Society for Testing Materials. Studies of routine test methods to ascertain the causes of discrepancies in test results obtained by different operators and the effect of test variables, such as temperature, humidity, etc., have been continued.

Tests of samples of caliche from bases of roads of good and poor service quality led to the publication of a report containing limiting test values for satisfactory varieties of this material. A similar report on linerocks has been prepared.



All investigations concerning soil stabilization have been combined under one project. A series of tests to determine the effect of physical and chemical admixtures on soils of the various subgrade groups is under way. These tests reveal the moisture content at which maximum compaction may be obtained and the densities that may be expected under various conditions of compaction and moisture. Tests on compacted samples are designed to show the resulting stability through measurement of percolation, expansion in the presence of water, and degree of softening when wetted. This series of tests will lead to the selection of mixtures to be investigated with use of a laboratory circular track. Promising developments from these tests will be investigated in the field.

When plastic soils are used in earth embankment construction, the best results are obtained only when moisture control and adequate compaction are provided. Certain soils are unsuitable for fill construction under any circumstances. Tentative specifications for the selection of embankment materials have been prepared and will be checked in practice. Continued investigation of the efficiency of different types of compacting equipment should furnish valuable information.

The low-cost-road field studies have included inspections and the tests of a number of samples from roads in service and correlation of test results and service behavior has resulted in a clearer understanding of the requirements for the improved soil road. A report, published in Public Roads, discussed the development and possibilities of this type of highway.

The large mileage of stabilized roads throughout the country emphasizes the necessity for suitable field apparatus for use in the selection of material and the control of the mixture. Considerable work has already been done on the drainage indicator for determining the percolation rate and capillary rise of soils. An extrusion test in conjunction with the drainage indicator gives promise of supplying valuable facts about the stability of graded mixtures. Further work on the sedimentation method for rapid mechanical analysis has led to the design of apparatus using a comparison microscope for determining grain sizes.

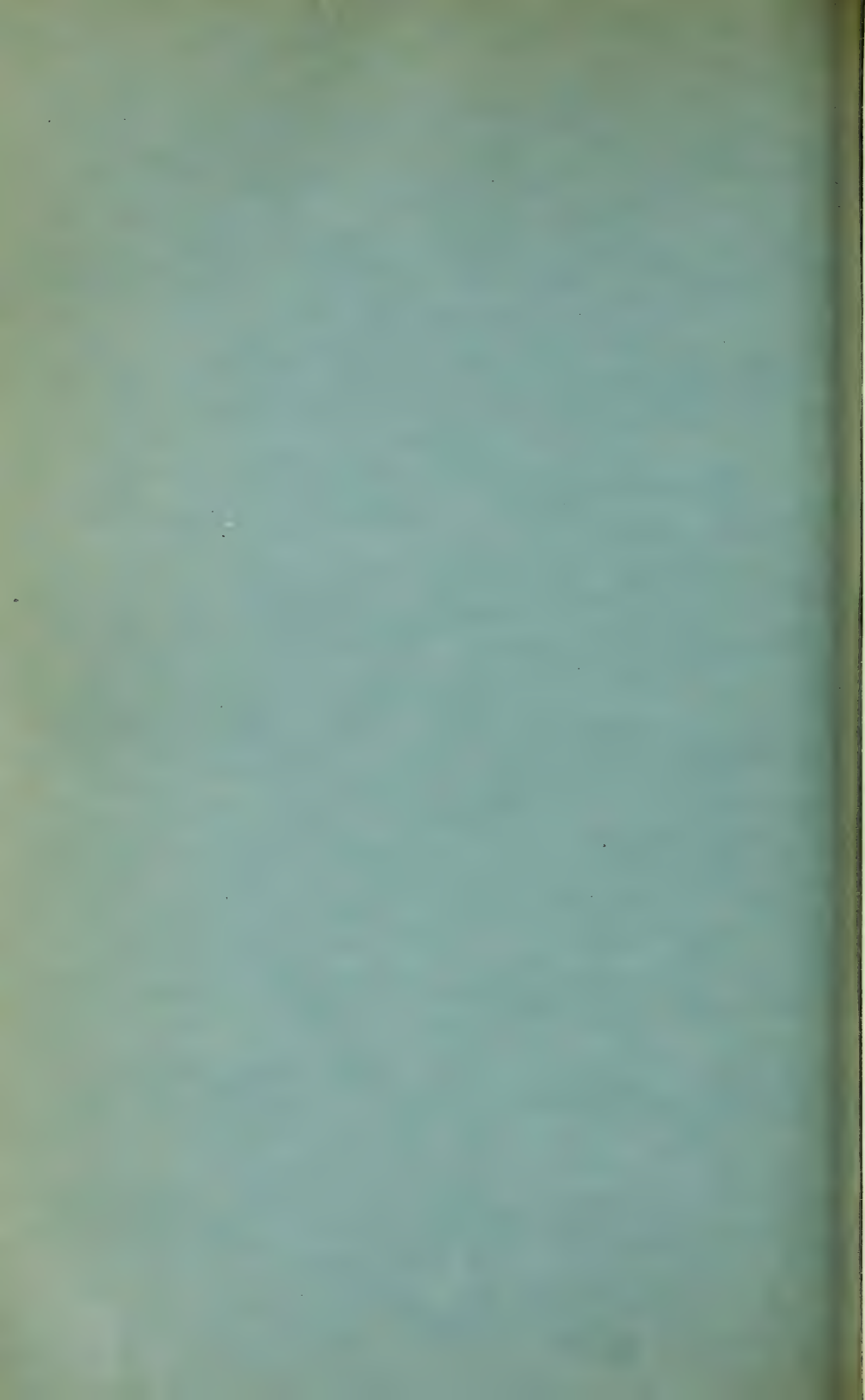
A cooperative investigation by the Bureau, the Missouri State Highway Commission, and the Missouri Agricultural Experiment Station was inaugurated in February 1935. Study is being made of the little-developed but highly important subject of surface chemistry of soils and base exchange in soil materials. It is indicated that a fuller understanding of the surface phenomena of soils will provide means for greatly altering the behavior of a given material. Progress is being made on the practical problem of utilizing wind-blown sand in highway construction. The use of soap as an electrolyzer in coating soil with bituminous material is a practical application resulting from a study of surface phenomena.

Three reports on specific projects, not previously mentioned, have been prepared for publication. They are: (1) A report on the microchemical method of analysis for the identification of chemicals that may be present in soils and ground waters and seem to be associated with concrete disintegration and warping; (2) a report on the analysis of data collected on the hydraulic fill at Four Mile Run on the Mount Vernon Memorial Highway, containing a comparison of computed and measured settlements; (3) a progress report on the Virginia demonstration road, discussing the effect of subgrade conditions, type of aggregate, reinforcement, crack-control methods, method of curing, and other variables as revealed by the condition surveys.

Cooperation with the State highway departments in the making of subgrade surveys, in the design of subgrade treatments and road surfaces, and in the establishment of subgrade-soil laboratories, has continued as in past years.







# REPORT OF THE CHIEF OF THE SOIL CONSERVATION SERVICE, 1935

UNITED STATES DEPARTMENT OF AGRICULTURE,  
SOIL CONSERVATION SERVICE,  
Washington, D. C., September 26, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I present herewith the report of the Soil Conservation Service for the fiscal year ended June 30, 1935.

Sincerely yours,

H. H. BENNETT, *Chief.*

## INTRODUCTION

Accelerated soil erosion is recognized by the Department of Agriculture as a major influence contributing to the deterioration of productive lands. As a problem affecting the continued welfare of agriculture, it needs no discussion here. Its importance finds sufficient emphasis in the research data assembled by the Department during many years of intensive experimentation.

Although the Soil Conservation Service was established originally as a unit of the Department of the Interior, it owes its origin, fundamentally, to the prior accumulation in the Department of Agriculture and the State agricultural experiment stations of scientific evidence regarding the seriousness of erosion and the necessity of its prevention. If the work undertaken by the Service represents a new approach to the problem of erosion control, that approach is rooted in the groundwork of essential information laid down by the research agencies of this Department and the States.

The reestablishment of the Service as a permanent bureau of the Department has made possible an integration of research and service activities which places upon a single agency, rather than upon several, the responsibility for effective action in the vitally important field of soil conservation. Certainly, from the standpoint of the Service, this was the most significant development of the year. In that it assures the coordination and continuation of national effort to preserve our soil resources, it should prove of even greater significance to the Nation.

## HISTORY

The Soil Conservation Service, as now constituted, is the outgrowth of the Soil Erosion Service, an agency established in October 1933 to carry out provisions of the National Industrial Recovery Act relating to the prevention of soil erosion. The present organization was set up in the Department of Agriculture through a series of administrative and legislative actions during the last half of the fiscal year.

On March 25, 1935, the Soil Erosion Service was transferred intact from the Department of the Interior to the Department of Agriculture, by order of the Federal Administrator of Public Works, with the approval of the President.

Two days later, on March 27, the Secretary of Agriculture directed the unification of all Department of Agriculture activities pertaining to soil erosion under the Soil Erosion Service. This order automatically expanded the organization to include the erosion-control experiment stations of the Bureau of Chemistry and Soils and the Bureau of Agricultural Engineering, the erosion nurseries of the Bureau of Plant Industry, and the Emergency



Conservation Work camps theretofore assigned to the Forest Service for erosion-control work on agricultural lands.

On April 27 the President formally approved an act of Congress (Public 46, 74th Cong.) declaring it to be the "policy of Congress to provide permanently for the control and prevention of soil erosion \* \* \*", and authorizing the Secretary of Agriculture to establish an agency to be known as the "Soil Conservation Service" to effectuate this policy. In accordance with language of the act authorizing the Secretary to "utilize the organization heretofore established", the Secretary designated the Soil Erosion Service as the Soil Conservation Service.

#### DEPARTMENTAL RELATIONSHIPS

The transition from an emergency agency of the Department of the Interior to a permanent bureau in the Department of Agriculture naturally entailed the necessity for a reorganization and reshaping of many Service policies and procedures. This was essential in order to correlate the activities of the Service and related agencies within and without the Department, and to accommodate the new research and service functions acquired as a result of the transfer.

Accordingly, an interbureau committee of the Department was designated by the Secretary to study the relationships between the Soil Conservation Service, allied bureaus of the Department, and cooperating State agencies. For 6 weeks this committee considered the subject in all its ramifications. Its report, containing detailed recommendations governing organization, policies, and procedures, was approved by the Secretary on June 6 and has become, in effect, a charter for the Soil Conservation Service.

In shaping the future course of Service activities, the report emphasized two factors, fundamental to the prosecution of a sound, national soil-conservation program. Concisely stated, these called for (1) coordination of the knowledge, experience, and facilities of the Service, the various bureaus of the Department, and cooperating State agencies; and (2) the formation, within a relatively short time, of legally constituted soil-conservation associations through which the Service might act after July 1, 1937, in carrying its program into direct application on the land.

To carry out its recommendations, the report suggested the creation of three permanent committees: One to correlate the activities of the Soil Conservation Service and the Agricultural Adjustment Administration; the second to foster necessary cooperative research relationships between the Service, the several bureaus of the Department, and the State experiment stations; and the third to maintain active cooperation between the Service and various other Federal agencies concerned both directly and indirectly in the work of soil conservation. These committees have been appointed by the Secretary and are functioning.

As a medium for coordinating the work of the Service and the various agencies within a State, the report recommended the formation of a soil conservation advisory committee—

to assist in formulating programs for all soil conservation work in the State, in coordinating the various agencies concerned with soil conservation, in locating demonstration and other projects, in encouraging the formation by farmers of soil conservation associations, and in otherwise contributing to a unified plan of action.

Included in the interbureau committee report were specific recommendations looking to the establishment of cooperative relationships between the Service and the Bureau of Agricultural Economics, the Bureau of Biological Survey, the Forest Service, the Bureau of Plant Industry, the Bureau of Entomology and Plant Quarantine, and the Extension Service. Memoranda of understanding between these bureaus and the Service were being prepared and approved as rapidly as possible at the close of the fiscal year.

The formation of legally constituted soil-conservation associations of farmers is being preceded by the formation of voluntary associations to serve as the link between the Government and the farmer during the period required to set up legal associations. The work of forming these voluntary groups, as well as the organization of the legal associations, is being fostered by the Service in close cooperation with the State extension services. In that it will substantially alter the operating procedures of the Service after July 1, 1937, that section of the report proposing the establishment of these soil-conservation associations is regarded as of signal importance.

Taken in its entirety, the effects of the interbureau report will be to integrate the activities of the Department, the Service, and cooperating State

agencies; to clarify supervisory and field relationships between the Service and other agencies concerned in soil conservation; and to define the policies and procedures of the Service as a whole.

### OBJECTIVES

Broadly stated, the objectives of the Service are, to propagate the use of soil conservation practices in agriculture through the medium of demonstration; to effect at the same time a maximum control of erosion on as large an area of agricultural land as possible; and to ascertain the fundamental scientific facts essential to the development and improvement of soil-conservation methods and technics.

In a general way, the program of the Service comprehends a functional approach to each of these objectives, and may be divided into distinct but interrelated fields of activity involving (1) the demonstration of practical and effective measures of soil conservation by (2) actual work upon the land in cooperation with landowners, and (3) the consistent development and improvement of such measures through research and investigation.

### FIELD DEMONSTRATION WORK

Since its inception the Soil Conservation Service has recognized the impracticability of attempting immediately to install erosion-control measures and soil-conservation practices on all, or any considerable portion, of the erodible lands of the country. Obviously, such an undertaking would prove impossible of completion by any single organization, not only because of the enormous acreage, but because of the varied and difficult human factors involved. The only sound, practical course, giving the greatest measure of assurance for eventual Nation-wide soil conservation was to seek the interest and active cooperation of agriculturists in the propagation of conservation practices. To this end, the Service is prosecuting a national plan of demonstration and education calculated to convince farmers of the necessity for, and the feasibility of, practical soil protection. In this program the principle of farmer cooperation is fundamental.

Equally fundamental is the element of coordination of method in land treatment. The Service insists that effective control of soil erosion can be achieved only through the combined application of approved principles of correct land use, the adoption of approved cultural practices, and the integrated employment of both engineering and vegetative methods, according to the peculiar needs and adaptabilities of the land.

### PROCEDURE

The orderly application of a definite land-use program within limited watershed areas of privately-owned land has necessitated the development of specific procedures governing the planning and prosecution of work.

If each area is to serve as a demonstration of erosion-control measures applicable to a large agricultural region, the problems presented within the area must be representative of those existing in the region generally. Likewise, if the plan is to be carried out in cooperation with farmers, there must be an evident willingness on their part to participate in the projected work. These two major considerations form the basis for the selection of demonstration areas.

Once the watershed has been selected, it becomes necessary, before actual planning can begin, to survey the entire area in order to determine existing land-use practice, chemical and physical soil characteristics, slope, degree of erosion, and other limiting factors which must be taken into consideration.

Translated into a detailed map, the results of this survey are carefully considered in the preparation of a balanced soil-conservation plan for the area in which all control measures, vegetative, mechanical, and cultural, are carefully integrated by the technical staff assigned to the project. This plan is presented to individual farmers with an invitation to participate in its application upon their land.

The measure of this cooperative participation is set forth in a formal contract under which the farmer agrees to comply, during a 5-year period, with the plans devised by the Service for his farm. This contract, stipulating the nature of the treatment recommended for the individual farm and setting forth in detail the burden of performance resting upon each of the contracting parties, is the vital link between the Service and the private owner of the land. A

facsimile of a properly executed cooperative agreement is shown on pages 4 to 7.

## APPRAISAL

In an accurate appraisal of the program of the Soil Conservation Service, major emphasis must be placed upon the nature of the objective toward which the efforts of the Service are directed. Essentially, this objective is to propagate the use of land-conservation measures through the medium of educational

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(March 1935)

A-51-SC-47

Original

UNITED STATES  
DEPARTMENT OF AGRICULTURE  
SOIL EROSION SERVICE

## COOPERATIVE AGREEMENT

## AGREEMENT FOR DEMONSTRATIONAL AND EXPERIMENTAL WORK IN SOIL EROSION CONTROL

The site of the work, with land description, cropping plan, and map attached hereto, are incorporated  
as part of the agreement

THIS AGREEMENT, entered into this Fourth day of April, 1935, by the  
United States of America, hereinafter called the Government, represented by the contracting officer executing this contract and

<u>Wheeler</u> (Last name)	<u>E. A.</u> (PRINT)	<u>Portland</u> (City)	<u>Oregon</u> (State)
<u>Mann</u> (Last name)	<u>A. N.</u> (PRINT)	<u>Portland, E. G.</u> (City)	<u>Oregon</u> (State)
(Last name)	(PRINT)	(City)	(State)
(Last name)	(PRINT)	(City)	(State)
(Last name)	(PRINT)	(City)	(State)

hereinafter called the Cooperator(s);

WITNESSETH, that the parties hereto do mutually agree as follows:

ARTICLE 1.—The officer in charge shall be the Regional Director, hereinafter called the officer in charge.

ARTICLE 2.—The Cooperator agrees to follow the cropping plan attached hereto, in accordance with the directions and under the guidance of the officer in charge or his duly authorized representatives, insofar as the officer in charge may find it necessary for the purposes of soil erosion control. The obligations of the Cooperator, however, shall be limited to those set forth in articles 3 to 23 inclusive

ARTICLE 3.—For a period of 5 years from the date of this agreement, the Cooperator agrees to continue all farming and forestry practices required by this agreement and to maintain all fences, terraces, and other structures erected pursuant thereto, in a condition and in a manner satisfactory to the officer in charge.

ARTICLE 4.—The Cooperator agrees to plant to grass, hay, or other erosion-resisting vegetation, at locations indicated on the attached map:

Field 4b - 2.5 acres to Alfalfa - grass mixture

Field 5a - 5.2 acres to pasture - grasses

(1)

demonstrations. The progress of the program, therefore, must be measured by the effect which these demonstrations have had upon agricultural thought and action.

The program of the Service has been a significant factor in awakening American agriculture to a fuller cognizance of the soil-erosion problem. During the year, a marked development of interest, not only on the part of farmers but also of business men and others only remotely connected with the land, was apparent. The problem of soil erosion and the vital necessity for protecting our soil resources from destruction by wind and water appear to have come for the first time to the attention of the entire Nation.



Spectacular midwestern dust storms were responsible in large part for this realization that soil erosion is a problem of national magnitude. It was the activity of the Service, however, which centered attention not only upon the cause, but upon the cure of these destructive phenomena.

This development of national interest in the conservation of soil resources is an accomplishment of major importance. The futility of attempting to effect control of soil erosion on agricultural lands without first creating a public

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The Cooperator further agrees to maintain in pasture grass or hay 37.9 acres, as indicated on the map. The plowing of permanent grass or hay land, the clearing of brush or woodland, and the grazing of pasture land shall be subject to the approval of the officer in charge.

The Government agrees to furnish seed, lime, fertilizer, and inoculating materials for areas taken out of cultivation as may be specified in cropping plan and enumerated below:

Field 4b - 2.5 acres - 30 pounds alfalfa seed, 8 pounds timothy, 1000 pounds

0-14-6 fertilizer, 5 tons limestone, and one can inoculation.

Field 5a - 5.2 acres - 100 pounds pasture mixture No. 1, 2000 pounds 0-20-0

fertilizer, and 10 tons limestone.

Field 5b - 30 rods - 4 strand barb-wire fence - 1.5 spools.

Field 7a - 30 rods - 4 strand barb-wire fence - 1.5 spools.

Fields 5b - 3.3 acres and 7a - 0.6 acre - trees for reforestation.

ARTICLE 5.—The Government agrees to make surveys and specifications for 19.4 acres of strip-cropping at locations indicated on the map. The Cooperator agrees to practice contour strip-cropping on said locations, as specified by the Government. No one cultivated crop shall occupy the same location for more than 9 years in succession.

ARTICLE 6.—The Government agrees to plant trees, shrubs, or other erosion-resisting vegetation on 3.9 acres, at locations indicated on map.

ARTICLE 7.—It is stipulated, since this stock is furnished free, that trees may not at any time be sold or disposed of, except as commercial wood products.

ARTICLE 8.—The Cooperator agrees to furnish all materials and labor which are available to him and may be required in such construction or relocation of fences as may be necessitated by the cropping plan attached hereto. When, in the opinion of the officer in charge, the Cooperator is unable to furnish such necessary materials or to furnish such labor, the Government agrees to assist the Cooperator in such construction and relocation of fences by furnishing such material and labor as the officer in charge deems necessary.

ARTICLE 9.—The Cooperator agrees to protect from grazing 31.4 acres, at locations indicated on the map.

Fields - 3, 5a, 5b and 7a

ARTICLE 10.—The Cooperator agrees to protect, to the best of his ability from fire, all wooded and other areas not used for farm crops.

ARTICLE 11.—The Government agrees to make surveys and specifications for contour-furrowing of pasture land on 8 acres, as indicated on map. The Cooperator agrees to perform said contour-furrowing according to the Government surveys and specifications. North end of field 1.

understanding of the problem is obvious. The Service feels that its program is rapidly bringing about this understanding and that it is, in addition, providing the guidance necessary to translate conservation thought into effective action.

With the demonstrational value of the program as the principal criterion of its effectiveness, the amount of field work actually performed becomes relatively unimportant. Physical treatment of the land within watershed demonstration areas must be measured not by its extent but by the service it performs in convincing farmers that erosion can be controlled through careful land use and certain practical measures of land treatment.

It has been impossible to maintain an accurate record of the number of farmers and other interested persons who inspected erosion-control work in the forty-odd demonstration areas of the Service during the year. A conservative estimate, however, would place the number at close to a quarter of a million. If each of these farmers represented only 50 acres of land needing protection from erosion, the demonstrations of the Service might logically be said to have extended some measure of influence to 12½ million acres of cultivated land outside of the demonstration areas.

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ARTICLE 12.—The Government agrees to make surveys and specifications for terraces on .....15..... acres, as mutually agreed upon. The Cooperator agrees to construct said terraces according to the Government surveys and specifications.

ARTICLE 13.—The Government agrees to furnish temporarily the following terracing tools and equipment, as available:

Tractor, terrace grader and slips.

ARTICLE 14.—The Cooperator agrees to do whatever .....team..... work is necessary for moving the local materials to build the following erosion-control structures, as agreed upon:

Structures in fields 1, 2, and 6.

ARTICLE 15.—The Government agrees to build the necessary structures and devices which may be deemed necessary and practical in special cases to prevent damage from uncontrolled waters entering upon farm from neighboring lands.

ARTICLE 16.—In order that the Government may direct and supervise the work, the farming and the forestry practices undertaken in this Agreement, the Cooperator shall allow the officer in charge and his duly authorized agents free access to any of the lands involved during the period of this agreement.

ARTICLE 17.—In the event that the Cooperator fails to fulfill his undertaking in a satisfactory manner the parties agree that the Government may terminate this agreement and shall be entitled to recover as liquidated damages the cost of materials (but not equipment) used by the Government, under this agreement.

ARTICLE 18.—The Cooperator agrees that the Government shall not be liable for any injury to person or property incurred in connection with the prosecution of the work under this agreement.

ARTICLE 19.—In consideration of the benefits to be derived from the establishment of the erosion-control practices adopted on the land, the landlord, tenant agrees to be bound by the terms of this agreement as though he were named as the Cooperator.

ARTICLE 20.—If at any time a party hereto shall cease to have any legal relationship (whether as landlord or tenant) to the land described on the map attached hereto and incorporated as part of the agreement, this contract shall become inoperative and of no further force or effect as to such party.

ARTICLE 21.—In event present or future farm legislation interferes with the cropping plan of this agreement the needed changes may be made subject to the approval of the officer in charge.

ARTICLE 22.—No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this contract or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this contract if made with a corporation or company for its general benefit.

ARTICLE 23.—It is understood and agreed that the United States is not bound by the terms of this agreement for any amount in excess of available appropriations nor beyond the period or periods authorized by existing law or as may be hereafter provided.

Aside from this exertion of influence, however, the Service feels that it may claim tangible results for the work actually performed within its demonstration-project areas. Important innovations in agricultural methods were introduced successfully in many sections where new crops, new measures of land protection, and new farming practices introduced by the Service found ready acceptance on the part of farmers.

The extent to which such improvements have been introduced is indicated by a comparative analysis of the demonstration work in all project areas.

Prior to initiation of the program, for example, the highly effective practice of strip cropping was employed on only 5,300 acres of the aggregate of

1,620,059 acres now covered by cooperative agreements. Under these agreements, farmers within the respective areas have inaugurated or agreed to inaugurate strip cropping on a total of 294,139 acres. This represents the adoption of strip cropping on approximately 34 percent of the total cultivated area under agreement.

The Sandy Creek, Ga., project was the only project on which as much as 1,000 acres was strip cropped before cooperative agreements were signed (actually the area classed as strip cropping here was more on the order of inter-terrace areas seeded to small grain), although some use of this practice was reported from the West Tarkio, Mo., the Cohocton River, N. Y., and the Crooked Creek, Pa., areas.

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The parties hereto have executed the same, the United States of America by the contracting officer, and the Cooperator has hereto signed his name and affixed his seal the day and year hereinabove written.

THE UNITED STATES OF AMERICA,

*John Doe*  
Regional Director.

(SEAL) *E. A. Wheeler* Cooperator. (Title—owner or operator)  
 (SEAL) *A. N. Mann* Cooperator. (Title—owner or operator)  
 (SEAL) \_\_\_\_\_ Cooperator. (Title—owner or operator)  
 (SEAL) \_\_\_\_\_ Cooperator. (Title—owner or operator)  
 (SEAL) \_\_\_\_\_ Cooperator. (Title—owner or operator)

WITNESS:

*Geo. Williams*  
*Geo. Williams*  
*John Doe*  
Contracting officer.

Projects on which strip cropping is an outstanding part of the erosion-control program, with the percentage of cultivated land to be so treated are:

Location	Percent
Buck and Sandy Creek, Ala.-----	93.25
Stillwater Creek, Okla.-----	91.41
Dalhart, Tex.-----	85.85
Gilmore Creek, Minn.-----	82.75
South Tiger River, S. C.-----	79.80
Pecan Creek, Okla.-----	77.29
Coon Creek, Wis.-----	77.63

Thirteen other areas, or 20 in all, report more than 50 percent of their cultivated land to be strip cropped, and 15 areas report less than 20 percent to be so handled.

Prior to initiation of the Service, contour tillage was practiced extensively on the Buck and Sandy Creeks, Ala.; Sandy Creek, Ga.; Okatibbee Creek, Miss.; South Tiger River, S. C., and South Palouse River, Wash., areas. The total so treated previous to the Soil Conservation Service program was 210,595 acres. This will be increased to 393,715 acres under the terms of cooperative agreements now signed, an increase of 86.9 percent. Projects introducing contour tillage on a larger scale, with the percentage of the cultivated land to be so treated, are:

Location	Percent	Location	Percent
Elm Creek, Tex.-----	93.8	Plum Creek, Nebr.-----	55.0
Stillwater Creek, Okla.-----	90.9	Limestone Creek, Kans.-----	30.0
Wildhorse Creek, Oreg.-----	82.7	Deep River, N. C.-----	26.5
East Cadron Creek, Ark.-----	56.0		



Terracing had been used extensively on the Buck and Sandy Creeks, Ala.; Sandy Creek, Ga.; Cooley-Bushy Creek, La.; Okatibbee Creek, Miss.; South Tiger River, S. C.; and Fishing Creek, S. C., areas before inauguration of the soil-conservation program. A total of 130,067 acres previously terraced was reported on all projects. Terms of the cooperative agreement will increase this area to 368,723 acres. Those projects increasing terracing most extensively are shown in table 1.

TABLE 1.—Increase in percentage of terracing in various projects after initiation of the Soil Conservation Service

Location	Before	After	Location	Before	After
	Percent	Percent		Percent	Percent
Elm Creek, Tex.....	1.06	93	Dalhart, Tex.....	.17	70
Deep River, N. C.....	.28	91	Reedy Fork, N. C.....	4.87	70
Brown Creek, N. C.....	1.85	85	East Cadron Creek, Ark.....	17.46	58
Stillwater Creek, Okla.....	5.60	84	Muckalee River, Ga.....	.28	55
Bannister River, Va.....		75	Limestone Creek, Kans.....	.83	53

Retiring land previously under cultivation to wood-lot or permanent hay or pasture is an important item in the erosion-control program. The following projects have stressed the retirement of land as a part of their land-use program. They are listed according to the amount of land retired, expressed in percentage of their previously cultivated land:

Location	Percent	Location	Percent
Reedy Creek, W. Va.....	45	East Cadron Creek, Ark.....	26
Gilmore Creek, Minn.....	42	Deer-Bear Creek, Minn.....	26
Coon Creek, Wis.....	39	Beaver, Minn.....	25
Shue Creek and Wolsey area, S. Dak.....	34	Salt Creek, Ohio.....	25
Crowleys Ridge, Ark.....	30		

Proper rotation as a means of controlling erosion has apparently been overlooked to a considerable extent in the past. Nine projects report that not a single acre of the cultivated land in the area was being handled in good rotations. The average of all projects shows that 20 percent of the aggregate area carried by demonstration projects had been properly rotated in the past, and an average of 67 percent under agreement would be so handled for the next 5 years.

Projects which have stressed the increase of proper rotations, also the increase in percentage of cultivated land to be so treated, are listed in table 2.

TABLE 2.—Increase in percentage of cultivated land in proper rotation in various projects after initiation of the Soil Conservation Service

Location	Before	After	Location	Before	After
	Percent	Percent		Percent	Percent
Shue Creek, S. Dak.....		133	Limestone Creek, Kans.....	15	96
Elm Creek, Tex.....	1	110	Stillwater Creek, Okla.....	3	94
Dalhart, Tex.....		100	South Tiger River, S. C.....	1	81
Muckalee Creek, Ga.....	28	100	Big Creek, Mo.....	3	76

Involving, as it does, the fact and principle of wise land use, the program of the Service is in accord with the broad objectives of the Department as they relate to a more careful utilization of land resources.

The program of the Service bears a direct relationship to the adjustment programs of the Agricultural Adjustment Administration. Approximately 15 percent of the cultivated land now being worked by the Service is being retired from cultivation and put into permanent pasture or forest by cooperative agreements with farm owners. Expansion of the program to include approximately 2¼ million acres of land within selected watershed areas will involve an increase in the amount of land retired. Likewise, the percentage of land taken out of cultivation under the cooperative contracts of the Service is expected to increase steadily as farmers become convinced that pasture and wood-lot management is more profitable than cultivating submarginal land or land not adapted to tillage because of its extreme susceptibility to erosion.

The extent of land-use reorganization in the demonstration areas is summarized in table 3.

TABLE 3.—Land-use and treatment program under cooperative agreements, June 30, 1935

State	Project	Area project	Acres covered by cooperative agreements	Cooperative agreements signed	Area covered by cooperative agreements	Area in cultivation for signing cooperative agreements	Area agreed to be reforested from cultivation	Increase in erosion-susceptible crops—percentage of contracted land	Decrease in tilled land, percentage of contracted land	Area to be reforested
		Acres	Acres	Number	Percent	Acres	Acres	Percent	Percent	Acres
Alabama	Buck and Sandy Creek	118,963	98,234	659	83	34,839	7,990	10.41	1.35	1,895
Arkansas	Crowley's Ridge	31,000	7,558	51	24	3,125	1,029	10.51	13.61	0
Do	East Cadron Creek	125,000	50,240	325	40	32,597	8,765	13.11	12.89	145
California	Las Posas	20,474	13,262	62	65	10,101	1,911	4.40	4.18	924
Do	Arroyo Grande	6,500	2,129	44	33	2,128	615	21.86	2.41	39
Do	Corralitos	71,080	2,141	48	3	1,502	55	2.57	2.57	0
Georgia	Muckalee Creek	55,000	23,201	83	42	10,556	734	6.55	1.929	65
Do	Sandy Creek	104,070	68,477	640	65	37,155	6,283	13.27	2,896	585
Illinois	Congersville 1	67,000	33,756	205	50	21,800	634	3.49	1.176	0
Do	Galva 1	96,000	43,564	259	45	30,492	1,409	2.11	9.22	0
Do	Sangamon Creek	150,581	99,620	577	66	82,699	10,598	13.48	5.310	59
Kansas	Limestone Creek	136,640	92,364	397	68	58,512	5,882	9.38	5.377	20
Louisiana	Cooley-Brushy Creeks	100,000	40,527	288	41	21,174	3,764	6.21	6.140	1,301
Minnesota	Beaver Creek	34,400	8,085	64	24	4,234	1,096	3.33	1.73	106
Do	Deer-Bear Creeks	94,500	8,677	66	9	5,945	1,554	3.61	3.39	72
Do	Gilmore Creek	5,600	4,913	44	88	1,838	786	4.57	2.99	108
Mississippi	155,000	49,911	361	32	15,335	1,547	6,642	13.30	4.042	398
Missouri	Big Creek	152,217	110,735	774	73	61,409	14,699	16,469	12,993	71
Do	West Tarkio River	102,217	67,254	409	66	54,195	7,353	10.93	10.93	0
Nebraska	Plum Creek	69,120	33,940	170	49	24,107	5,071	3,732	10.99	10
New Jersey	Raritan River	37,000	33,276	2	1	171	10	0	10	3.71
New York	Colocation River	154,000	10,101	79	7	6,348	1,062	5.61	3.85	288
North Carolina	Brown Creek	65,000	51,533	460	79	17,329	1,615	5.033	1,607	539
Do	Reedy Fork	48,215	15,356	203	32	26,288	1,047	18.64	1,559	23
Do	Deep River	138,640	86,993	1,145	63	6,819	2,591	8.75	3,479	873
Oklahoma	Pean Creek	43,000	7,921	80	18	5,044	585	11.51	11.95	0
Do	Stillwater Creek	173,000	75,478	581	44	26,598	4,321	3,652	4.83	355
Oregon	Wildhorse Creek	31,300	15,066	68	48	12,568	1,011	1,699	0	11
Ohio	Salt Creek	92,000	44,678	385	49	15,108	3,874	6.11	9.99	1,207
Pennsylvania	Crooked Creek	120,000	24,933	186	6	10,101	716	9.65	1,203	49
South Carolina	South Tiger River	104,750	54,972	691	52	15,093	3,313	9.79	1,784	340
Do	Shue Creek and Wolsley area	190,000	23,224	93	12	5,056	5,732	10.42	4.928	1,620
South Dakota	Duck Creek	22,744	9,507	74	42	13,453	4,645	0	0	51
Texas	Dalhart	27,447	2,447	41	100	22,921	927	3.40	4.25	0
Do	Elm Creek	156,000	73,326	580	47	61,790	955	24.91	24.91	0
								3.55	4.82	0

1 Emergency Conservation Work camp areas.

TABLE 3.—Land-use and treatment program under cooperative agreements, June 30, 1935—Continued

State	Project	Contour tilled					Strip cropped			Terraced			Farmed in good rotation		
		Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements
Virginia	Bannister River	Acres 133,737	Acres 74,662	Number 610	Percent 49	Acres 28,463	Acres 5,545	Acres 11,935	Percent 15.99	Acres 2,632	Acres 3,52	Percent 3.52	Acres 573	Percent 3.52	Acres 573
Do.	Sandy River	28,604	859	65	3	675	105	380	44.23	128	0	35.65	3	128	3
Washington	South Palouse	100,000	53,141	272	53	46,983	7,828	17,595	33.11	0	0	0	184	0	184
West Virginia	Reedy Creek	152,000	52,228	437	34	6,412	2,891	3,164	6.05	2,189	4.19	4.19	3,448	2,189	3,448
Wisconsin	Coon Creek	92,000	43,399	413	47	16,988	6,725	1,326	3.05	640	1.47	1.47	643	640	643
Total		3,674,859	1,611,162	12,061		883,330	136,638	169,249		99,707			16,055	99,707	16,055

State	Project	Contour tilled			Strip cropped			Terraced			Farmed in good rotation		
		Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment	Area before cooperative agreements	Area under cooperative agreements	Percent- age of land be- fore sign- ing co- operative agree- ment
Alabama	Buck and Sandy Creek	Acres 32,487	Acres 32,487	Percent 93.25	Acres 0	Acres 26,215	Percent 93.25	Acres 31,772	Acres 1,770	Percent 91.19	Acres 10,546	Acres 30.27	Percent 30.27
Arkansas	Crowley's Ridge	0	1,933	61.85	0	50	61.85	450	0	14.40	1,933	61.85	Percent 61.85
Do.	East Cadron Creek	548	18,293	56.11	50	5,676	56.11	18,923	1,000	58.05	18,293	56.11	Percent 56.11
California	Las Posas	6,700	9,546	94.50	0	0	12.50	571	0	5.65	35	34	Percent 34
Do.	Arroyo Grande	180	959	45.06	0	0	20.30	432	0	20.30	0	132	Percent 6.20
Do.	Torraltos	0	434	28.86	0	266	17.71	0	10	66	0	109	Percent 7.25
Georgia	Muckalee Creek	5,048	9,453	89.55	0	6,765	64.08	5,866	2,976	55.57	10,556	100.00	Percent 100.00
Do.	Sandy Creek	34,166	34,880	93.87	3,280	24,539	66.04	26,782	5,560	72.08	14,170	38.13	Percent 38.13



Illinois	Congressville 1	0	147	67	823	3.77	120	695	3.18	585	3,026	18,00
Do	Galva	0	130	16	100	13	50	600	2.77	26,880	29,003	95,37
Do	Sangamon Creek	1	1,407	194	6,308	7.70	50	2,387	2.88	24,727	74,893	90,56
Kansas	Limestone Creek	40	17,986	30,73	8,126	13.88	490	31,192	53.30	9,070	56,335	96,27
Do	Cooley Brushy Creeks	15,817	15,208	72,10	12,584	59.43	16,104	161,924	76.89	6,517	17,205	81,25
Do	Beaver Creek	120	310	7,32	2,984	70.47	93	2,772	6.42	2,825	3,773	89,11
Do	Clear-Beck Creeks	1,405	23,95	23,95	2,984	49.92	0	299	5.03	2,749	4,225	71,06
Do	Gilmore Creek	1,521	82,75	82,75	1,521	82.75	0	0	1,532	1,703	92,65	
Do	Okanabee Creek	14,788	96,43	96,43	4,908	60.43	12,687	9,268	60.43	3,671	12,349	80,52
Do	Big Creek	6,808	11,18	11,18	5,406	8.80	249	5,799	9.44	2,077	46,937	76,43
Do	West Fork River	3,015	26,27	26,27	1,356	2.50	0	503	9.2	9,669	34,840	64,28
Do	Plumb Creek	13,454	55,72	55,72	1,719	7.13	0	15,619	64.79	19,418	25,961	106,44
Do	Earlian River	131	76,97	76,97	1,110	64.66	0	171	0	171	171	100,00
Do	Cochoten River	3,096	48,77	48,77	3,408	54.63	0	272	0	354	6.04	6.04
Do	Brown River	14,574	84,10	84,10	3,037	17.52	590	14,843	85.65	1,732	17,329	100,00
Do	Reedy Fork	5,661	83,02	83,02	2,540	37.25	332	4,767	69.90	9,355	4,985	73,10
Do	Deep River	23,578	89,69	89,69	5,274	20.06	75	24,101	91.98	5,000	2,286	8,69
Do	Pecan Creek	3,993	79,16	79,16	3,899	77.29	612	3,109	61.63	0	4,108	81,44
Do	Stillwater Creek	300	24,182	90,91	24,315	91.41	1,511	22,403	84.22	770	25,167	94,61
Do	Wildhorse Creek	580	10,374	82,54	3,661	29.12	0	258	0	258	2,416	19,22
Do	Salt Creek	240	4,012	26,55	3,488	23.08	0	175	0	2,831	8,533	56,48
Do	Crooked Creek	1,586	2,973	72,49	2,289	55.81	0	1,705	0	2,740	4,407	107,46
Do	Fishing Creek	10,988	13,257	87,83	9,258	61.33	11,689	12,373	77.55	9,272	12,373	81,97
Do	South Tiger River	23,381	25,850	81,43	25,333	79.80	23,762	20,044	63.14	341	25,786	81,23
Do	Shue Creek and Wolswey Area	0	0	0	17,996	133.76	0	0	0	217,838	17,838	132,59
Texas	Duck Creek	2,861	3,724	70,17	3,395	72.18	1,147	1,493	31.73	0	3,668	77,99
Do	Dalhart	0	16,264	70,96	19,679	85.85	40	16,264	70.95	0	22,921	100,00
Do	Elm Creek	654	58,074	93,98	10,838	17.54	654	16,264	70.95	561	58,170	94,14
Do	Bannister River	2,343	18,579	65,29	4,343	15.26	0	21,414	75.26	2,128	23,191	81,50
Do	Sandy River	68	598	88,59	417	61.77	0	771	0	43	9,556	82,37
Do	South Palouse	46,983	100,00	100,00	0	0	0	0	0	1,174	9,768	20,78
Do	Reedy Creek	0	48	75	1,500	23.39	0	0	0	761	3,521	54,91
Do	Coon Creek	0	15,361	90,42	13,019	76.63	0	2,342	13.78	14,511	16,123	94,91
Total		210,596	488,114	---	297,198	---	130,070	369,227	---	153,676	630,406	---

**Emergency Conservation Work camp areas.**

Including some previously idle land.

Perhaps the most accurate yardstick for measuring farmer response to the program is to be found in the number of landowners voluntarily signing cooperative agreements which bind them to follow for 5 years the erosion-control plans and practices mapped out for their farms by specialists of the Service.

In less than 2 years, 12,061 farms covering 1,620,059 acres have been brought under these voluntary contracts. This is 38.7 percent of the farms and 39.6 percent of the acreage included in the several demonstration areas of the Service. In addition, 13,354 farmers, representing an aggregate of 1,751,650 acres, have asked the Service to enter into contracts covering their lands.

In considering these figures, it should be noted that three of the demonstration areas are scarcely underway. The percentage of cooperation on the part of farmers is considerably higher in those areas where the program has had time to function. At Dalhart, Tex., in the Panhandle wind-erosion area, every farm and every acre included in the project working area has been covered by a cooperative contract.

Likewise, it should be noted that the contracts are based entirely upon farmer cooperation, stipulating only the extent to which each of the contracting parties assumes responsibility for the work. The individual farmer volunteers his land for the purposes of a Government demonstration, and the Government, in return, agrees to direct and in part to perform the work necessary to effect control of erosion on the land involved.

Although major emphasis is placed on the effectiveness of the program from a demonstrational standpoint the work performed on the 4,091,500 acres included in the 44 demonstration areas on private land, constitutes a material advance in the control of soil erosion. These accomplishments are summarized as follows:

#### STATUS OF PRIVATE LAND DEMONSTRATION PROGRAM, JUNE 30, 1935

Projects.....	number.....	44
Area in private land (demonstration) projects.....	acres.....	4, 091, 500
Farms in demonstration projects.....	number.....	31, 145
Cooperative agreements signed.....	do.....	12, 061
Area covered by cooperative agreements.....	acres.....	1, 620, 059
Farms under agreement.....	percent.....	38. 7
Total area under agreement.....	do.....	39. 9
Agreements canceled.....	number.....	185
Area involved in canceled agreements.....	acres.....	24, 999
Invitations received from farmers to make contracts.....	number.....	13, 354
Area covered by invitations to make contracts.....	acres.....	1, 751, 650
Farms with treatment finished.....	number.....	3, 074
Area on which treatment completed.....	acres.....	598, 896

#### PROGRAM AGREED TO UNDER COOPERATIVE AGREEMENTS

Area to be strip cropped.....	acres.....	294, 768
Area to be contour tilled.....	do.....	392, 489
Area to be terraced.....	do.....	369, 724
Area to be contour furrowed.....	do.....	49, 117
Area to be planted in erosion-resisting rotations.....	do.....	617, 858
Area to be retired from cultivation.....	do.....	136, 242
Area to be put to permanent hay and pasture.....	do.....	99, 265
Area to be put to forest.....	do.....	39, 057
Increased area of erosion-resisting crops.....	do.....	170, 656
Decreased area of clean-tilled crops.....	do.....	99, 703

#### PRESENT STATUS OF PROGRAM

Area strip cropped.....	acres.....	175, 700
Area contour tilled.....	do.....	233, 897
Area contour furrowed.....	do.....	24, 661
Area with erosion-resisting rotation in effect.....	do.....	439, 591
Area retired from cultivation.....	do.....	96, 617

#### FIELD WORK COMPLETED

Terraces constructed.....	miles.....	10, 891
Permanent terrace outlets constructed.....	number.....	22, 041
Temporary terrace outlets constructed.....	do.....	41, 499
Terrace outlets seeded and sodded.....	square yards.....	680, 533
Terrace outlet channels completed.....	linear feet.....	2, 490, 219
Temporary dams constructed in gullies.....	number.....	100, 843
Permanent dams constructed in gullies.....	do.....	12, 665
Bank sloping, gully control.....	square yards.....	6, 189, 061
Diversion ditches, gully control.....	linear feet.....	1, 023, 582
Area drained by controlled gullies.....	acres.....	191, 468
Water-spreading dikes.....	linear feet.....	164, 787

## FIELD WORK COMPLETED—continued

Area planting:		
Forestation	acres	16, 054
Gully planting	do	9, 963
Planting, bank protection	square yards	10, 738, 838
Seed collections:		
Hardwoods	pounds	238, 875
Conifers	bushels	3, 360
Area under forest management	acres	169, 193
Woods pasture fenced	do	40, 562
Demonstration plots, forest management	number	218
Cooperators, wildlife management	do	2, 036
Fence constructed	rods	288, 892
Area in fire-hazard reduction	acres	21, 648

## FEDERAL LAND PROJECTS

In addition to the demonstration projects on private land, the extensive erosion-control activities were carried out on three projects comprising large areas of federally owned land in the Southwest. These projects, one covering 17,000,000 acres in the Navajo Indian Reservation in New Mexico and Arizona, another embracing 8,200,000 acres on the Upper Gila River watershed, and the third including 12,000,000 acres on the watershed of the Rio Grande, are operated on a somewhat different basis than the private-land demonstrations. Public ownership of most of the land in these areas obviates to a large extent the necessity of formal cooperative agreements with private landowners.

## NAVAJO PROJECT

The Navajo project includes all of the Navajo, Hopi, and Zuni Reservations in the watershed of the Colorado River. The area is in an advanced stage of depletion, as regards both soil and vegetation. Accelerated erosion, to the detriment of grazing, agriculture, forests, and irrigation works, as well as the soil in general, is proceeding at a rate which threatens the existence of the Navajo people, and the future of the entire area. The only possible remedy lies in the regulation of land use, the reestablishment and maintenance of proper soil conditions through grazing control, and a general social readjustment to keep pace with the process of land rehabilitation.

It is not practicable to remove the Navajo to other lands or greatly to enlarge his present holdings. Hence, the problem must be worked out while the land remains in use.

The general objective of the project is to rebuild the lands of the area by (1) checking destructive erosion and conserving the water supply, (2) regulating the use of forage and forest cover, (3) promoting the best practices of agriculture, forestry, and other phases of land use, and, in cooperation with the Indian Service, integrating land use with the other arts, occupations, and problems of the Navajo people, and (4) by furnishing the Indians with profitable employment and useful training in land management insofar as is consistent with the program.

Demonstration areas have been established at Mexican Springs, Canyon de Chelly, Chilchinbito, Cove, Frazer, Ganado, Kayenta, Klagetech, Mariano Lake, and Moenave. Within these areas, approximately 161,581 acres have been brought under cooperative agreement with the Indians. In addition to the demonstration project, an erosion experiment station and soil conservation nurseries are in operation at Mexican Springs.

Because of the relatively small area under cultivation within the project, the most important problem involves the management of range lands. Range surveys had been completed on more than 5,000,000 acres at the close of the fiscal year. Complete range-management plans will be developed for each major division of the area upon completion of the survey. All operations on the project are conducted in close cooperation with the Indian Service, the Forest Service, and the Taylor Grazing Act Administration.

Probably not much over 1 percent of the project area is suitable for agriculture and a substantial portion of this 1 percent would not be considered as farm land according to the usual standards. A survey is under way to determine the location and extent of the areas on the reservation that can be used advantageously for such crops as corn, pumpkins, squash, and fruits by spreading waste water over the lower flats. Both the Navajo and Hopi Indians utilize flood plains for cultivation, but this land is of an unstable nature and is characterized by wide variations in production from year to year. Sheet,



gully, and wind erosion are all severe in the southwestern portion of the Navajo Reservation. In all, only about 50,000 acres of the entire project area are in farms, the remainder being used as range.

Completed irrigation projects make water available for approximately 25,600 acres. Of this acreage, however, probably less than one-sixth has been leveled and made ready for application of proper irrigation practices.

Almost all farming in the project area is for subsistence only, but the aggregate production is inadequate to supply the needs of the people. The Navajo population is increasing in almost geometrical proportion, while the land sufficiently fertile to produce crops is actually decreasing.

Control of erosion in the watershed of the upper Colorado bears an important relationship to the prevention of silting in Boulder Reservoir.

#### GILA RIVER PROJECT

The upper Gila River project in Arizona and New Mexico includes over 4,000,000 acres in national forests, approximately 1,000,000 acres within the boundaries of the San Carlos Indian Reservation, more than 2,500,000 acres of public domain, and nearly 750,000 acres of State land, of which approximately 600,000 acres are leased to private individuals or corporations. Private lands total about 400,000 acres, of which less than one-tenth is fit for cultivation.

Erosion over the entire watershed outside of the national forests is in an advanced and serious stage. Certain areas, such as those adjoining the San Simon River, present probably the starkest example of sheet and gully erosion in the United States. On other tributary streams of the Gila, similar but less extensive conditions of erosion are found. Great areas, formerly well grazed and, within the memory of living men, affording splendid pasturage for cattle, are now practically stripped of vegetation and intersected by huge arroyos. Much of the mesa land, which once provided fine pasture, is now almost wholly denuded of everything except a scanty growth of weeds, grasses, creosotebush, and cacti.

The problem on this project is principally one of revegetation by a planned system of range management, combined with such methods of natural and artificial measures of erosion control and moisture conservation as are practical in such an extensive area.

Five Civilian Conservation Corps camps on the project have constructed 67 stock tanks, which are regarded as one of the most successful phases of work to date. Although the summer rainy season was very late in 1935, 40 percent of the tanks contained water and probably 25 percent were completely filled, indicating their dual value in conserving moisture and in providing water for stock.

Other work done by the Civilian Conservation Corps camps assigned to the project included the construction of check dams, flood-control dams, water-spreading dikes, drainage and diversion ditches, and similar structures designed to prevent excessive erosion and to conserve the moisture supply.

Although approximately 90 percent of the working area within the Gila project is public domain, work on private land or on State-leased land is done in cooperation with the landowner. Cooperative agreements covering 199,900 acres of land have been signed by 98 ranchers and farmers.

Gully-control treatment was finished on 35,057 acres during the year, and an additional 10,319 acres were being worked when the year ended.

#### RIO GRANDE PROJECT

On the Rio Grande project, the problem involves disastrous floods, the rapid silting of Elephant Butte Reservoir and the bed of the Rio Grande, the loss of large agricultural areas because of accelerated erosion, and wide-spread range and woodland depletion. In the relatively brief time since the project was established, work in the area has consisted for the most part of survey operations.

Solution of the problems involves the regulation of range wherever possible, and, where outright regulation is impossible, the fostering of cooperative effort in the reestablishment of adequate vegetation; and the introduction of farm- and range-management methods which will establish soil conservation on a permanent basis. This involves close cooperation with private landowners and operators, with the Indian Service, the Taylor Grazing Act Administration, the Forest Service, the Rio Grande Conservancy District, and various other State and private agencies.

## STATUS OF FEDERAL LAND PROGRAM, JUNE 30, 1935

Projects.....	number.....	3
Area in Federal land projects.....	acres.....	37, 200, 000
Area on which survey is completed.....	do.....	5, 011, 877
Area yet to be surveyed.....	do.....	32, 188, 123
Area on which treatment is finished.....	do.....	125, 099
Temporary dams constructed.....	number.....	107, 125
Permanent dams constructed.....	do.....	66, 245
Bank-sloping gully control.....	square yards.....	62, 969
Diversion ditches for gully control.....	linear feet.....	59, 603
Drainage area of gullies controlled.....	acres.....	101, 634
Fill in each dam.....	cubic yards.....	316, 311
Water-spreading dikes.....	linear feet.....	473, 250
Area planting, forestation.....	acres.....	5, 966
Area planting, gully control.....	do.....	3, 696
Planting for bank protection.....	square yards.....	7, 356, 024
Seed collections:		
Hardwoods.....	pounds.....	3, 578
Cowpeas.....	bushels.....	1, 010

## RELATED FIELD OPERATIONS

## CONSERVATION SURVEYS

In the field of surveys, the most important work of the year was the completion of a Nation-wide reconnaissance erosion survey and presenting of data in an erosion map of the United States.

The survey covered every county in the United States. Fieldwork was performed by 111 soil technologists of the Soil Conservation Service, assisted by 6 men from various State soil surveys, 6 men from the Soil Survey Division of the Bureau of Chemistry and Soils, and 9 men from the erosion experiment stations of that Bureau.

In order to provide maps and data on erosion for the land-planning report of the National Resources Board, the survey was completed in 2 months, beginning August 15, 1934. To expedite completion of the map and report in this extremely short time, the National Resources Board placed 40 draftsmen and statistical clerks at the disposal of the Service.

Data obtained by the survey, while incomplete and applicable only in the most general way, furnish the best guide available to date relative to the distribution and character of erosion throughout the United States.

The reconnaissance included not only the character and distribution of soil erosion, but the degree of slope, prevailing kind of soil (where that information was not already available from soil surveys), and present use of this land. It was recognized that the designation of erosion conditions would be of much greater value if shown in relationship to the other important land-use factors. Because of insufficient personnel, however, it has been impossible thus far to prepare data or maps showing the relationships of erosion to the other factors. This work is planned for the next fiscal year.

## RESULTS OF RECONNAISSANCE SURVEY

The tabulation of reconnaissance data has furnished the most reliable index of actual erosion conditions thus far available.

The area covered by the survey comprised 1,903,176,620 acres, of which 144,768,315 acres of mountainous, rough land, and scablands were not classified in detail. In the arid areas in the western part of the United States it was also found impossible, in many localities, to differentiate accelerated or man-induced erosion from normal geological erosion during the brief time available for the survey.

Of the 1,377,092,156 acres exclusive of this western mountainous and inter-mountain basin region, however, evidence of accelerated or man-induced erosion in one form or another was found either of frequent occurrence or as a prevailing characteristic within an area comprising 832,083,436 acres. Not all this erosion was serious, and many areas were not eroded at all, although falling within a general category of eroding land. For instance, 48,959,596 acres were found, over which, generally, there were scattering gullies but no extended, serious sheet erosion.

Serious erosion was found to be much more wide-spread than expected, however. The survey revealed that the greater part of an area of 44,213,837 acres outside of the arid western region had been essentially destroyed by



wind or water erosion insofar as general use for crop production is concerned. Most of this had been cultivated and once was good soil.

A loss of practically all of the topsoil from the greater part of an area of 86,782,934 additional acres was determined by the survey. Much of this land, however, is not entirely unsuited for further tillage but most of it has been materially reduced in productivity.

In addition to this severely eroded area the survey showed an aggregate of 467,875,940 acres on which from one-fourth to three-fourths of the topsoil had been lost over more than 25 percent of its extent. The cultivated portion of this moderately eroded area is rapidly losing its topsoil, but much of it is still productive and is well worth saving. The major problem in conservation of agricultural lands is concerned with the lands falling within this category.

A large area was found to be seriously affected by wind erosion, principally in the Middle Western States east of the Rocky Mountains and extending from Texas to North Dakota. The survey showed a total area of 4,219,799 acres, over which more than one-fourth has been essentially destroyed for cultivation, while more than 25 percent of the farm land included in an area of 56,489,503 acres was damaged by wind erosion to such an extent as seriously to affect agricultural values.

With respect to 167,755,664 acres included in the total eroding area of 832,083,436 acres, erosion is rapidly getting under way on numerous areas. This is an important part of the remaining area of more valuable agricultural land and must be preserved at all costs.

#### SUMMARY OF RECONNAISSANCE SURVEY DATA

Area within which more than 25 percent of the land has been affected as indicated:

	<i>Acres</i>
Lost practically all of the topsoil and severely gullied, rendering it unsuited generally for further tillage. Includes much abandoned land-----	48,959,596
Lost practically all of the topsoil, generally. That portion still under cultivation is for the most part of low agricultural value. Includes much abandoned land and much submarginal land inefficiently farmed--	86,782,934
Lost one-fourth to three-fourths of the topsoil, generally. That portion in cultivation is advancing toward the preceding class but is still suitable for continued tillage where adequate conservation measures are adopted. In the neighborhood of 50,000,000 acres of this--mainly patchy areas--have been very severely damaged-----	467,875,940
Area with more or less severe wind erosion on land in cultivation-----	56,489,503
Area within which most of the land essentially ruined for further tillage by wind erosion-----	4,219,799

In connection with the reconnaissance survey, the Service developed a system for indicating indirectly on a base map the various relationships between the four major factors affecting soil conservation and land use, namely, character of erosion, kind of soil, degree of slope, and present land use. The development of this system included perfection of a method for accurate evaluation and designation of erosion conditions, whether sheet erosion, gully erosion, wind deposition, or wind removal.

During the year, two erosion survey conferences were held, one at Meridian, Miss., in January, and one at Colorado Springs, Colo., in May. The first was attended by members of the field staff in charge of soil work, and the second by field men in charge of soil work in the wind-erosion regions.

#### DETAILED EROSION SURVEYS

A knowledge of the conditions of erosion and their relationships to degree of slope, kind of soil, and present land use is essential to the development of soil-conservation plans. At the close of the fiscal year, 165 men were engaged in making detailed surveys to supply this information.

These surveys are used by the soil conservationist on each project as the basis for making cooperative agreements with the farmers, and by the technical staff in determining the nature of the land-treatment plan to be applied to each cooperating farm.

Prior to this use, the soils staff of the project usually prepares a suggested plan of treatment for each condition of erosion, slope, type of soil, and land use applicable to the entire project area. In this set of recommendations suggestions are made as to the cropping system, the crop rotation, and the proper use for lands falling within each class of erosion and slope. The



classes of land to be taken out of cultivation and those to be kept in close-growing crops are indicated, and variations in strips for strip cropping are suggested. These recommendations are general in character and are modified by the technical staff according to individual needs, as shown by a detailed erosion map of each cooperating farm.

These detailed erosion maps show degree and type of erosion, slope by specific groups, soil types, and present land use.

The slope of the land directly influences erosion. Slope groups are established on the basis of land-use adaptations and necessary erosion-control measures. Group A covers flat areas upon which there is a minimum of erosion under normal conditions of tillage or other usage, and includes flat areas having a slope ranging from 0 to 2, 3, or 5 percent, depending on the section of the country being surveyed. The second, or B group, includes that range of slope on which, under prevailing conditions of use, erosion is active on areas in cultivation but on which effective control measures can be established. The range for this group varies in different parts of the country. Thus, in the piedmont area, the group includes land with slopes ranging from 3 to 10 percent. Elsewhere, it may include slopes ranging from 5 to 25 percent. The third, or C group, includes slopes on which clean-tilled crops should not be grown, but which may be used for close-growing crops or for pasture. These slopes are too steep to permit erosion control when put to clean-cultivated crops, but can be used for grain, legumes, and similar crops if planted in rotation to provide cover throughout the year. The fourth, or D group, includes slopes generally too steep to permit effective erosion control if continued in cultivation.

The actual percentage limits for these groups vary in different parts of the country and with different soils. Some soils are less erodible than others, and therefore can be cultivated on steeper slopes. Others, more subject to erosion, have relatively low limits of gradients for safe cultivation.

Water erosion is mapped in 5 classes of sheet erosion and 3 classes of gully erosion. Wind erosion is divided into removal and accumulation of soil by blowing.

Soil types are classified according to the system established by the Bureau of Chemistry and Soils.

Land use is indicated in four main groups, namely, cultivated land, forest, pasture, and idle land. Subdivisions of the land-use separations are sometimes made where further information regarding the distribution of crops is needed.

The various classifications of erosion are as follows:

#### 1. Sheet erosion:

Class 1. Areas showing no apparent erosion.

Class 2. Areas with slight sheet erosion: Less than 25 percent of the A horizon removed.

Class 3. Moderate to serious sheet erosion: 25 to 75 percent of the A horizon removed.

Class 4. Severe sheet erosion: Over 75 percent or all of the A horizon lost by sheet erosion.

Class 5. Very severe sheet erosion: Sheet erosion to or extending into the C horizon (parent material, or geological material).

#### 2. Gully erosion:

Class 7. Occasional gullies: Three gullies or less per acre, or gullies 100 feet apart laterally.

Class 8. Frequent gullies: More than three gullies per acre, or gullies less than 100 feet apart laterally.

Class 9. Destroyed by gullies: Includes areas so thoroughly dissected that the land is destroyed for further cultivation, and areas destroyed by a single large gully.

#### 3. Wind erosion:

Class F. Level accumulation 0 to 6 inches deep.

Class G. Hummocky accumulations 0 to 6 inches deep.

Class H. Level accumulations 6 to 12 inches deep or more.

Class K. Hummocky accumulations 6 to 12 inches deep.

Class L. Hummocky accumulations 12 to 24 inches deep.

Class N. Small dunes 24 to 60 inches deep.

Class O. Dunes over 60 inches deep.

Class R. 0 to 75 percent of A horizon removed.

Class S. Over 75 percent of the A horizon and some upper B horizon lost.

Class T. Wind erosion of lower B horizon and possibly into C horizon.

## EMERGENCY CONSERVATION WORK CAMPS

During the fiscal year, the Service operated an average of 85 Emergency Conservation Work camps. The assignment of camps, by camp periods, is shown in table 4:

TABLE 4.—Assignment of Emergency Conservation Work camps

Period	Number of camps	Number of camp months
July 1, 1934, to Sept. 30, 1934.....	34	102
Oct. 1, 1934, to Apr. 1, 1935.....	51	306
Apr. 1, 1935, to June 30, 1935.....	205	615
Total camp months.....		1,023
Average camps operating through year.....	85	

A description of the work accomplished by the camps would be largely a duplication of the work report of the Service, since the camps supplied a substantial portion of the labor required to carry out work planned by the staff technicians in project areas.

Some indication of the Emergency Conservation Work operations may be obtained, however, from statistics showing accomplishments in the various lines of erosion control. During the fiscal year Civilian Conservation Corps workers under the Soil Conservation Service constructed 294,132 check dams for gully control; seeded and sodded 82,209,213 square yards of gully bank; sloped 58,465,864 yards of gully bank; and completed 2,857,264 linear feet of diversion ditches and dikes to carry water away from potential gully sites. As an essential complement to the terracing program, the Civilian Conservation Corps workers constructed 27,341 temporary and permanent terrace-outlet structures and 718,874 linear feet of outlet channels. To protect steep slopes where erosion was prevalent, 10,115 acres were planted to trees.

Lesser items include the construction of 390 miles of fences, the construction of 359 miles of minor trail, stream-bank protection to the extent of 2,991,114 square yards, miscellaneous planting of 13,076 acres for the prevention of sheet erosion, and fighting forest and grass fires.

Encouraged by results of these camps during the past fiscal year, the director of emergency conservation work allocated 542 Civilian Conservation Corps camps to the Soil Conservation Service for the next period. While all erosion camps in the past have been operated directly with demonstration areas of the Service, many of the new camps will work as independent erosion-control units, carrying on cooperative demonstration work on areas of about 18,000 acres each. These camps are expected to treat, in the next 12 months, more than 6,100,000 acres of farm lands now suffering soil losses from both water and wind erosion.

Toward the close of the year, plans were made for the establishment of erosion-control camps to carry out soil-conservation work in cooperation with conservancy districts and voluntary and legal soil-conservation associations of farmers. These camps will become the working medium of the Service in carrying out the cooperative relationships being established with conservation districts and associations throughout the country.

## NURSERIES

The Division of Nurseries was established in the Soil Conservation Service in April 1935 to administer the erosion-control nurseries transferred from the Bureau of Plant Industry.

At the time of the transfer the Bureau of Plant Industry was operating 20 nurseries. Much of the work under way was experimental, dealing with the collection of promising native and foreign erosion-control plants, and the development of propagation methods for immediate increase.

Since the transfer of the nurseries, quantity production of planting stock for the entire Soil Conservation Service has been emphasized, but the collection work continues.

The Division of Nurseries is divided into three sections, (1) tree and shrub work, (2) grass work, and (3) purchases. In the last-named section, technical



supervision is maintained over all purchases of seeds, limestone, fertilizers, and other agricultural supplies.

#### TREE AND SHRUB WORK

Nurseries for the production of the material needed in erosion-control planting have been established by three separate agencies during the past 2 years. During the fiscal year, all were brought together in order to centralize responsibility for growing or procuring planting materials for the soil-conservation projects.

In addition to the nursery activities directly under the Service, plants are being produced in State nurseries, through cooperation with the United States Forest Service, and by leases of commercial nurseries. In addition, some trees have been purchased direct from commercial growers. On January 30, 1935, approximately 274,000,000 trees were being produced either directly or by cooperative agreement.

In view of the enlarged program of soil conservation, the total acreage and total production of planting stock in Service nurseries are being considerably increased. Through elimination and consolidation of several small nurseries, however, the total number of nurseries will remain about the same.

The nurseries are primarily occupied with the immediate problem of furnishing necessary planting stock to the project areas and Emergency Conservation Work camps of the Service. From this standpoint they are concerned with large-scale, cheap, efficient, and sure production of species known to be adapted to the areas concerned. However, the nurseries are also concerned with securing plants better adapted to the broad conservation program than present types and are working in very close cooperation with the Bureau of Plant Industry in collecting planting material and studying methods of propagation to rapidly increase promising species. This means that a large number of kinds of native and introduced plants are being brought together and propagated in small quantity for experimental use in erosion control. A few examples of such plants now under propagation are special selections of black locust, honeylocust, American Plum, Scotch pine, walnut, hickory, and cedar.

A summary of the present sources of supply for nursery stock is given in table 5.

TABLE 5.—*Tree and shrub nurseries, Jan. 30, 1935*

Agency initiating	Nurseries	Area in trees and shrubs	1935 production of trees and shrubs
	Number	Acres	Number
Bureau of Plant Industry.....	20	1, 029	70, 000, 000
Emergency Conservation Work.....	18	658	121, 000, 000
Soil Conservation Service (project nurseries).....	17	199	37, 500, 000
United States Forest Service shelter-belt cooperation.....	5	93	8, 500, 000
State cooperation.....	19	-----	39, 000, 000
Total.....	79	1, 979	274, 000, 000

#### GRASS WORK

Six nurseries have been established in the Great Plains and Western States to serve as centers for the study of native vegetation and its use in erosion control.

The studies include collection, identification, distribution, methods of propagation, and increase of all species having potential value as erosion-control plants. During the 1934 season, over 600 species of native plants were collected, identified, and grown in the erosion-control nurseries to determine their value for erosion control on field projects of the Service.

Climatic conditions are such throughout most of the western Great Plains and other dry lands of the West that cultivated species of grass cannot be used in establishing vegetative cover on abandoned agricultural lands. For this reason recourse must be made to native grass species which are able to withstand the prevailing extremes of temperature, moisture, and soil. Most of these native grasses occur only in mixed stands and in locations that make the task of harvesting a very difficult one. The demand for large quantities of



native grass seed has led to the formation of a bulk seed-collection program which has developed into a major activity of the soil-conservation nurseries of the Western States.

In May a conference was held at Colorado Springs to discuss and determine seed requirements. Estimates made by representatives of the various soil-conservation projects are shown in table 6. Since that time, total needs have increased to approximately 1,000,000 pounds.

TABLE 6.—*Estimates of amount of native grass seed needed and acreage required to harvest this seed as shown by soil conservation nurseries for 1935*

Species	Seed required	Acres required by stations						Total
		Tucson	Pull- man	Still- water	Ames	Man- dan	Chey- enne	
	Pounds	Acres	Acres	Acres	Acres	Acres	Acres	Acres
<i>Agropyron spicatum</i> .....	100,000	500	500					1,000
<i>Agropyron smithii</i> .....	163,000	200		100	1,000	1,000	100	2,400
<i>Andropogon scoparius</i> .....	210,000			1,500	1,500			3,000
<i>Andropogon ternarius</i> .....	500			50				50
<i>Bouteloua curtipendula</i> .....	500			100				100
<i>Bouteloua gracilis</i> .....	78,000	500		2,000	14,000	500	500	17,500
<i>Bouteloua hirsuta</i> .....	500			100				100
<i>Chloris verticillata</i> .....	50			10				10
<i>Elymus virginicus</i> .....	1,000			50				50
<i>Hilaria jamesii</i> .....	20,000	2,000						2,000
<i>Oryzopsis hymenoides</i> .....	8,000	200	500				100	800
<i>Panicum obtusum</i> .....	4,000	100		300				400
<i>Panicum virgatum</i> .....	2,000	25		50	25			100
<i>Poa sandbergii</i> .....	38,000		3,800					3,800
<i>Sorghastrum nutans</i> .....	1,000			10	10			20
<i>Sporobolus airoides</i> .....	22,500			1,000	1,000		250	2,250
<i>Sporobolus cryptandrus</i> .....	8,000		500	300	500	200	100	1,600
<i>Sporobolus flexuosus</i> .....	4,000	800						800
Total.....	661,050							35,850

Table 6 indicates a need for 330 tons of native grass seed distributed among 18 species. The demand for seed of any one species is dependent on availability, ease of gathering, and general adaptability of the species in question.

Regular farm machinery will be used wherever possible in order to keep the cost of harvesting as low as possible. Special machinery is being devised in an attempt to harvest seed of buffalo grass and grasses that are poor seeders, such as blue grama. Farm and relief labor are to be used wherever it is necessary to employ additional help.

#### SMALL-SCALE COLLECTION

In addition to the bulk-seed-collecting program, the nurseries will be centers for small-scale collections being made with the hope of finding all native plants having a potential positive value in erosion control. Plants collected during the season of 1934 are being grown in the nurseries during the present season, and notes are being made as to their agronomic characteristics.

Distribution charts are compiled showing the range and habitat of all species collected. Identification and taxonomic relationships as determined by A. S. Hitchcock, of the Bureau of Plant Industry, are accepted as final for all native plants collected.

#### EXPERIMENTAL INFORMATION

Experimental data relative to method, rate, and date of planting are obtained in cooperation with the Bureau of Plant Industry from test plots placed at different locations on farms throughout the soil-conservation-project areas. These plots are demonstrational in character and give essential information as to proper method of establishing a vegetative cover with the native grasses.

Studies relative to causes for low percentage of caryopses set have been carried out, and attempts to correlate temperature and moisture conditions at critical stages of development have been made. Germination tests have also been made in an effort to find reasons for low viability of seed when handled like cultivated grass crops.

Harvesting machines of various types have been developed to care for the harvesting of special types of grasses. Chief among these should be mentioned the power stripper, similar to the bluegrass commercial stripper but adjustable as to height, and powered from an ordinary truck chassis. A special suction type machine is being developed for the harvesting of buffalo grass seed. This machine is a vacuum sweeper in type of construction, and if successful in gathering the seed of this low-growing short-grass species, will be of great value in developing the grass program in the Plains area where wind erosion has been so destructive in recent years. Estimates of the amount of native grass seed needed and the acreage required to harvest this seed as shown by soil-conservation nurseries for 1935 are given in table 6.

#### TECHNICAL SUPERVISION OF PURCHASES OF SEED AND AGRICULTURAL SUPPLIES

From June 30, 1934, to July 1, 1935, invitations to bid on various items of seed, seedlings, plants, and fertilizer supply were mailed to approximately 1,000 commercial seedmen. As a result of these advertisements purchases approximating 7,728,000 pounds of field-crop seeds, 82,000 pounds of tree seeds, 4,535,000 tree seedlings, and 383,000 kudzu crowns or plants were made. In addition, 60,454,000 pounds of agricultural limestone and 20,352,000 pounds of fertilizer of various mixtures were purchased.

Soil-conservation-project managers in the field issued invitations to purchase approximately 110,000 pounds of crop and tree seed, 18,800,000 pounds of agricultural limestone, 4,308,000 pounds of commercial fertilizer, 2,125,000 kudzu crowns and seedlings, and 8,774,000 trees and seedlings. All bids on these supplies passed through the Division of Nurseries for recommendation as to award.

In order successfully to issue invitations to bid on farm-crop seeds, it was necessary to build up a mailing list of several thousand firms. Many of these commercial business houses were not interested; many firms are interested in only 1 or 2 kinds of seed and, in a few instances, special varieties.

All advertisements for seeds, trees, and fertilizers issued from the Washington office are written and prepared for mailing in the Division of Nurseries.

### REPORTS OF DIVISIONS

#### DIVISION OF CONSERVATION SURVEYS

Numerous changes were made in the Division of Conservation Surveys during the year in an effort to bring under one supervision those units concerned with erosion surveys and to coordinate their work in the interest of maximum efficiency.

The Division is charged with the primary responsibility of directing erosion surveys and mapping the results. In addition to the head of the Division, two inspectors assisted in directing survey operations. The number of inspectors proved inadequate, and plans have been made to increase the staff during the coming year.

#### DEVELOPMENT OF PERSONNEL

Since the mapping of erosion is comparatively new, few trained men were available for survey work. A course in surveying erosion was set up by the Division in connection with the general courses developed by the Service. College graduates with special training in soils or geology were given intensive training in the mapping of erosion, soils, and slope.

In setting up these courses, the Service cooperated with the various State agricultural colleges in giving work to worthy graduates who had been unable to find positions. One hundred and twenty-two thus trained were enrolled by the various projects, and many of these have been placed in permanent positions, either on the projects or in Emergency Conservation Work camp areas.

Within the Division are the sections of photogrammetry, drafting, and report.

The section of photogrammetry supervises the making of aerial surveys of project areas and other areas in which detailed erosion surveys are to be made and translates the aerial photographs into base maps. Aerial photography has proved the speediest and most accurate method of obtaining the information required for compilation of these base maps.



During the latter part of the fiscal year, the purchase of photogrammetric and field-survey equipment needed for the preparation of planimetric maps from aerial photographs was completed and the work of compilation started. Planimetric maps are being made at an accuracy recommended by the Federal Board of Maps and Surveys.

A summary of photogrammetric work completed on each project is given in table 7.

TABLE 7.—Photogrammetric work completed to June 30, 1935

Project no.	Project name and location	Contractor	Area	Cost
			Square miles	Dollars
1	Coon Creek, Wis.		145	
2	West Tarkio Creek, Iowa-Mo.	King Aerial Surveys	165	1,127.88
	Big Creek, Mo.-Iowa	do	290	1,660.20
	McLean County, Ill.	Aerial Explorations, Inc.	119	480.00
3	Sangamon River, Ill.	King Aerial Surveys	207	1,981.02
	Experimental station, Dixon Springs.	Wallace Aerial Surveys	21	177.20
4	Elm Creek, Tex.	King Aerial Surveys	323	1,925.23
5	South Tyger River, S. C.	Aerial Explorations, Inc.	173	603.00
7	Ventura project, Calif.	Fairchild Aerial Surveys, Inc.	70	490.00
9	Stillwater Creek, Okla.	King Aerial Surveys	276	1,233.89
10	Navajo project, Ariz., N. Mex., and Utah.	Fairchild Aerial Surveys	25,000	190,000.00
11	Limestone Creek, Kans.	King Aerial Surveys	178	1,065.58
12	Brown Creek, N. C.	do	93	555.14
	Deep River, N. C.	do	216	1,291.68
13	Reedy Creek, W. Va.	Aerial Explorations, Inc.	135	899.30
14	Zanesville, Ohio.		145	
15	Cypress Creek, La.	King Aerial Surveys	70	474.48
	Crocker and Brushy Creeks, La.	do	85	590.16
16	Plum Creek, Nebr.	do	108	744.69
17	East Cadron Creek, Ark.	do	180	1,186.20
18	Sandy and Buck Creeks, Ala.	do	180	1,126.89
19	Sandy Creek, Ga.	do	166	992.68
20	Duck Creek, Tex.	do	33	250.40
21	Okatibbee River, Miss.	do	225	1,626.75
22	Bannister River, Va.	do	228	1,648.44
	Sandy River, Va.	Wallace Aerial Surveys	45	508.00
24	New York State.	Standard Air Service	(1)	592.68
25	Gila River, Ariz., and N. Mex.	Fairchild Aerial Surveys, Inc.	22,000	71,280.00
26	Deer and Bear Creeks, Minn.	Aerial Explorations, Inc.	235	1,495.00
	Beaver Creek, Minn.	Holmberg Air Mapping Co.	53	600.00
27	Dalhart, Tex.	King Aerial Surveys	196	1,500.00
28	Reedy Fork, N. C.	Bowman-Park Aero Co.	74	890.00
29	Crooked Creek, Pa.	Aero Service Corporation	210	2,125.00
30	Fishing Creek, S. C.	Bowman-Park Aero Co.	81	870.75
31	Corralitos Creek, Calif.	Fairchild Aerial Surveys, Inc.	105	3,023.20
32	Raritan River, N. J.	Aero Service Corporation	57	1,145.16
33	Wolsey area and Shue Creek, S. Dak.	Aerial Surveys, Inc.	300	2,597.15
34	Rio Grande watershed, N. Mex.	Fairchild Aerial Surveys	35,000	187,950.00
35	Crowley's Ridge, Ark.	Bowman-Park Aero Co.	49	497.50
36	Cohocton River, N. Y.	Fairchild Aerial Surveys, Inc.	234	2,642.80
37	Muckalee Creek, Ga.	Aerial Surveys, Inc.	93	875.00
38	Pecan Creek, Okla.	King Aerial Surveys	56½	1,042.00
89	Black Squirrel Creek, Colo.	do	234½	3,600.00
	Smoky Hill River, Colo.	do	250½	
	Mossac Creek, Ky.	Wallace Aerial Surveys	42	404.30
40	Survey of Boulder Reservoir, Ariz. and Nev.	Fairchild Aerial Surveys	2,350	5,530.00
	Total		88,500½	410,674.35

<sup>1</sup> Flight line across State.

<sup>2</sup> Approximate.

## DRAFTING SECTION

The Drafting Section does the drafting for all divisions. Its principal work during the fiscal year, however, was the preparation of maps from detailed and reconnaissance erosion surveys.

In connection with the reconnaissance erosion surveys it was necessary to assemble base maps of all kinds for the entire country. Copies of all available county maps, soil maps, post office maps, United States Geological Survey topographic maps, War Department topographic maps, and all other available



maps in the United States, having a scale suitable for use by field men in plotting erosion data, were secured. A majority of these have been indexed and filed in the Washington office.

The personnel of the Section fluctuated in size during the year. The National Resources Board furnished 37 draftsmen for 3 months in order to expedite completion of the United States reconnaissance erosion map by November 2, 1934. Upon termination of these temporary appointments, the number of permanent draftsmen was increased in order to prepare the various State erosion maps for lithographing and to perform the routine drafting work of the Service.

Upon completion of the reconnaissance survey, the assembling and plotting of data for each State presented an enormous task. A map showing the classification of erosion in each of the 48 States was assembled and plotted in detail. These maps were made on United States Geological Survey base maps on a scale of 1:500,000. Three copies of each State map were made and hand colored—1 for the Washington office, 1 for the State Planning Board of the Agricultural Adjustment Administration, and 1 as a lithographer's guide for reproduction purposes. Each classification area was planimeted.

Lithographers were consulted and estimates on cost of reproducing 48 State maps in color on a scale of 1:500,000, and a United States map on a scale of 1:500,000,000, were prepared. Specifications were written, bids received, and contracts made for reproduction in color of approximately 30 percent of the State maps. Proofs have been checked for color shade, wrong colors, plate work, register, and other mistakes. Lithographed copies of 20 percent of the State maps have been finished and delivered. Requests from the regional offices, agricultural schools, various Government offices, State planning boards, and similar organizations, for these maps are being filled as the maps are published.

As detailed soil-erosion surveys are completed on the various project areas, copies of the maps are sent to the Division of Surveys where they are checked and planimeted by the drafting section to determine the extent in acreage of the different classes of erosion, slope, land use, and types of soil. This work is now in progress.

A filing system to meet the special needs of the section was developed and placed in operation; special filing cases for odd size and roll drawings and maps were designed and built; and standard sizes and titles for other drawings were adopted.

Additional activities included the preparation of an outline map of each project area showing the drainage and location of principal towns; a soil map showing soil types in the sections of those States affected by the proposed shelterbelt; the preparation of three maps for the Tennessee Valley Authority showing the distribution and classification of erosion, slope, and land use, respectively; the plotting of field notes and production of several finished maps for the Division of Sedimentation showing sedimentation and silting conditions of reservoirs.

#### REPORT SECTION

The report section tabulates and analyzes the results of erosion surveys, tabulates and consolidates progress reports from the field, and assembles other data required by the various divisions.

During the year this section accomplished the following work:

(1) Compiled and tabulated the results of the national reconnaissance erosion survey by counties, States, and major watersheds.

(2) Began analysis and tabulation of results of the detailed soil-erosion surveys as rapidly as the areas were planimeted in the drafting room. The relationships of erosion to slope, soil type, and land use are shown in these tabulations.

(3) Performed miscellaneous statistical work for all divisions and prepared fiscal statements.

(4) Tabulated and summarized monthly progress reports from the projects. These covered all activities of each of the projects. This information is kept available to all divisions as reference, and a report showing the status of funds, personnel, and progress of the work is prepared each month for the National Emergency Council.

## DIVISION OF WOODLAND MANAGEMENT

The Division of Woodland Management formulates fundamental principles of establishing, protecting, and managing woodland growth in conformity with sound erosion-control practice and in such manner as to enhance the economic utility of woodlands. This involves the adaptation of these principles to local conditions through development of practicable and adequate woodland-management plans, and leadership in integrating these plans with the general erosion-control program. The work of the Division involves five closely related lines of activity—wood-lot management, controlled planting, community forests, wildlife management, and woodland plant utility.

## SECTION OF WOOD-LOT MANAGEMENT

The Section of Wood-lot Management is concerned with improvement of farm wood lots and other woody growth in the erosion-control demonstration and work areas. The protection and improvement of such native growth is very important, since it usually occupies the steepest slopes and most erodible soils. For purposes of erosion control, it is obviously more desirable to retain a vegetative cover than to resort to more costly measures of replacement. Also, farm wood lots furnish fuel, posts, and other products and provide profitable work for men and teams when other work is slack. The farm-management plan must provide for systematic care of timber. The making of fire lanes, the removal of snags and dangerously inflammable material, the organization of local forest-fire suppression units, the fencing of woodland areas to exclude grazing animals, and the application of cultural measures to improve the crop and curb or control damaging insects, diseases, and rodents are important phases of this work.

Many woodland products now are wasted through lack of knowledge of their utility. Specialty woods are cut for fuel or ties through failure to recognize their high commercial value. Many trees produce fruits which can be substituted profitably for high-priced forage and mill feeds. A wide variety of nuts and berries can be used to enrich farm living or sold to add to farm income. A farm or community industry can be built up out of maple-sugar products, Christmas greens, baskets, medicinal plants, and similar byproducts of the woodlands. The potential value of farm woodlands when managed with the care and attention given to other farm crops offers possibilities of financial return comparable with that from cultivated lands. Farm woodlands can be used in such manner as to increase both their commercial and erosion-control values, and at the same time derive steady annual returns from them. Hence in farm planning for control of erosion, emphasis is placed on developing these potential woodland crops to the fullest practicable extent.

The major objective is to demonstrate to farm owners how to manage their wood lots for products of high quality, how best to utilize and market the products, and how to maintain first-class conditions for growth of timber to conserve soil and water effectively. The wood-lot management problem is complicated by the multiplicity of species which must be dealt with, and by the fact that the crop-management possibilities of shrubs and woodland plants other than trees is virtually an unexplored field. The problem is further complicated by the many biological and economic relationships involved in the close association of woodlands with agricultural lands.

## SECTION OF CONTROL PLANTING

The Section of Control Planting gives directions for restoring woodland vegetation to gullies, worn-out fields, barren and eroding slopes, wind-eroded plains and stream banks. In control of erosion it is necessary to take large areas out of cultivation and plant them to trees and shrubs. This is the only effective, low-cost, self-liquidating method of preventing soil and water losses on cleared lands unsuitable for cultivation or pasturage. Where erosion has completely destroyed the usefulness of the land for other crops woody plants afford means of slowly rebuilding the soil.

The effectiveness of such revegetating operations depends on the application of a high degree of technical knowledge in selecting adapted species for planting, devising suitable mixtures of species, and using planting stock and methods which assure effective and economically practicable results. From 5 to 15 percent of the labor available to the Soil Conservation Service is utilized in



woodland planting, so that even minor improvements in planting procedures and technique are important. During the past year many such improvements have been made in planting tools and planting methods. At the same time, many plants not previously used, or improved forms of common species, have been utilized. Last year 120 different species of trees and shrubs, totaling 30,225,000 plants, were set out on erosion-control projects. Injurious insects and diseases must be guarded against, and the use of plants avoided which may become pestiferous weeds or which may otherwise become harmful to man, animals, or beneficial vegetation.

The erosion-control program calls for a decided reduction in the acreage of cultivated lands. Much of this area to be taken out of cultivation is not too steep and still has sufficient soil to permit its use for pasture. The steepest pasture land and the severely gullied or otherwise totally worn-out and destroyed areas are assigned for development as woodlands. These lands present a critical problem, since failure to control gullies and to hold water on the steepest slopes means failure to control erosion.

Shrubs, trees, vines, and other woody plants common to woodlands are designed naturally for reclaiming lands ruined by reckless clearing and cultivation. The cost of revegetating such areas is wholly repaid by the public benefit through control of disastrous floods and prevention of damage to valley lands by silting and washing. But direct cash returns may also be obtained, since it is possible to apply the principles of farm management to woodlands, just as they are applied to other crop plants. Such work is still in its infancy on the technical side; patient development and broad vision will be required to make woodland crops assume equal importance with other crops in the eyes of the average farmer.

Much more is known about the planting, care, and management of trees than is known about the use of shrubs on wild lands. The great variety and adaptability of shrubs and the undeveloped status of wild-land shrub management offers an opportunity in this field of erosion-control planning. The foresters engaged in soil conservation activities must be capable of demonstrating practicable methods of commercial production, and in addition they must be pioneers in the field of shrub management, for which as yet we have no other term than "woodland management." This field has been touched on one side by the wildlife specialists, and on the other by range-management experts, but the main development rests with the erosion-control planting experts. If the importance of this matter is well understood, developments can be so directed as to transform completely the general apathy of farmers to woodland care, for the reason that shrubs can be made to produce commercial returns much earlier than most trees.

This section is trying to develop such simple measures in connection with the work of the Woodland Division as will, at no added cost, encourage increase of wildlife in general, and especially, in connection with lands taken out of cultivation, to protect them from erosion. A second objective is to demonstrate to farmers practicable methods of developing an annual replaceable increment of game, fur bearers, and game fish as a means of providing supplemental compensation for land taken out of agricultural production. The financial returns from wildlife management have been demonstrated as of high value to farmers in many localities.

#### SECTION OF COMMUNITY FORESTS

The Section of Community Forests promotes the withdrawal of highly erodible lands from cultivation and their dedication to public use by developing measures that encourage community ownership and management of such lands. Extensive areas of such lands are best reclaimed through community effort. This requires cooperation with many public and private agencies involved in such an enterprise. It also requires the formulation of principles and policies for selecting and managing the lands best administered under public ownership in harmony with soil-conservation objectives. Lands acquired as community property must be developed for forestry, grazing, wildlife, recreation, and other uses under adequate organization and management plans. This requires an inventory of resources, the adoption of control and protective measures against fire, diseases, insects, and other damaging agencies, and the development of such cultural measures and improvements as may be required to insure soil conservation and adequate use of the area by present and future generations.

The work of the Division centers mainly in developing proficiency and integration in the activities of a large technical personnel in the regional offices.



demonstration control projects, and Emergency Conservation Work camps. The work supervised by the foresters and wildlife men of the Division is distinctive in that it covers the entire field of woody vegetative cover.

The possibilities of increasing the economic value of woodland planting through better knowledge of the plants and their uses already has been demonstrated by work with shipmast locust. This locust variety has been grown in a limited area since 1700 but because of difficulties in reproducing it has not been widely grown. Black locust is one of the best trees for erosion-control planting. The improved variety is much straighter than the common form, its wood is much more durable for posts, and it appears to be much more resistant to the black locust borer than is the common locust. Methods have been developed whereby planting stock of the improved form of locust can be produced at reasonable cost, and plans call for the use of this variety to replace common locust in erosion-control planting operations as rapidly as the stock can be produced. A number of other trees and shrubs having superior economic and erosion-control values are being used in test plantings.

#### SECTION OF WILDLIFE MANAGEMENT

Wildlife management is closely related to woodland planting. It is often practicable to select trees and shrubs for planting that will furnish food and shelter for wildlife and at the same time advance the other objectives of erosion-control planting. Proper care in protecting and managing natural woodlands is possible at no additional cost and may be done in such manner as to favor the increase of game, fur-bearing animals, and birds. The regulation of stream flow through erosion-control practices not only checks floods, insures a continuous water supply, and reduces silting, but makes conditions favorable for game fish.

#### SECTION OF WOODLAND PLANT UTILITY

The importance of woodland planting may be judged by the fact that there are many million acres of land virtually destroyed by gullies, where woody vegetation is the best means of stopping damage and reclaiming the soil for some useful purpose. Much of the enormous area of severely sheet-eroded land needs to be rehabilitated through woodland planting. On some of the large areas of land severely damaged by wind erosion the establishment of shrubs is the best means of holding the soil and furnishing forage.

The Section of Woodland Plant Utility deals with highly specialized phases of planting and plant utility, and acts as a service unit in bringing about the effective utilization of woodland plants. Vital to the success of the erosion-control program is the development of every practicable means for increasing the economic returns and benefits from the extensive woodland areas which must be maintained under the program. Land taken out of cultivation must furnish revenue or landowners cannot afford to make the changes in land use required under the program. Information on economic culture and utilization of cultivated crop plants and grasses is extensive, but comparatively little is known, or has been made available, about the culture and use of woodland plants other than trees. This section cooperates with the technical and research agencies that deal with the many phases of plant utility and makes this information available for development of the specialized work of the Division.

#### DIVISION OF ENGINEERING

Engineering assumes an important place in a program of erosion control based on the treatment of land in accordance with its need and adaptability. The application of engineering principles is essential in the design and construction of terraces and terrace-outlet channels; in the mechanical aspects of gully control, involving the construction of check dams, and diversion and detention structures; and in the control of erosion along stream banks, lake shores, and highways. Principles of hydraulics and hydrography must be applied in calculating the rates of water run-off from agricultural areas, and in designing protective structures for the passage of run-off water down erodible slopes.

The Division of Engineering directs the application of these principles in the development of a completely integrated erosion-control program for each of the project areas of the Service. This involves the adaptation of mechanical

principles to local land conditions and a constant effort to increase the practicability of this type of land treatment by a reduction in costs.

During the fiscal year, improvements were made in the design of various types of engineering structures, in their application to local conditions, and in methods of construction. For example, in the southeastern projects a straight-walled masonry spreader dam constructed with the crest level with the channel floor and without aprons has been developed for the protection of terrace outlets. In the Blacklands project in Texas, a newly developed type of formless concrete dam effects much saving in labor and materials. These and similar advances have resulted in reduced costs and more effective control.

Improvements in the design and utilization of mechanical equipment also were effected. As an example, it was found that a 9- or 10-foot blade on a terracing machine can be operated much more economically and with the same power as the standard 8-foot blade. Consequently, 9- and 10-foot blades have been made standard equipment for power-terracing machines.

Advances of exceptional importance were made in the mechanics of gully control. The year's experience showed, in general, that treatment of the watershed drained by the gully is more effective, in many cases, than treatment of the gully. Consequently, lister furrows or small terraces designed and placed to divert water from the gully head have proved more efficient and economical than a series of check dams and other structures in the gully.

Improvements in terracing during the past year centered largely in the adaptation of terracing principles to local conditions, and in the introduction of terracing into new territory. The year saw a considerable advance in design and construction of terrace equipment, with resultant economies in use.

Some progress was recorded in the design and protection of terrace-outlet channels, although this work is relatively new and will require some experimentation before definite designs can be recommended. Each project using these structures has been experimental to a certain degree. The experience of the year has indicated the approximate run-off velocities permissible in outlet channels protected with various types of vegetation or mechanical devices.

In regions of light precipitation, water conservation is a vital factor in erosion and flood control, as well as in promoting an effective range-management program. Emergency Conservation Work camps in several Western States have engaged in a number of water-conservation projects, varying from the construction of relatively large dams impounding several hundred acre-feet of water, to the installation of level terraces or contour lister furrows so designed and constructed as to increase absorption and retard run-off.

All heavy construction and transportation equipment used by the Service was purchased on specifications prepared by the Division of Engineering. Performance records were kept on construction equipment with the idea of eliminating those units unsuited for erosion-control operations, or those requiring excessive operation or maintenance charges. Several labor-saving machines have been invented and developed by project engineering staffs and existing construction equipment has been improved through the cooperation of manufacturers. On the Kansas project, a sod-cutting machine which removes a strip of sod and places it right side up and in a continuous strip along the top of the contour ridge has been perfected for use in pasture-contour work. The machine will also cut sod and load it into a truck or wagon at one operation.

In response to the need for information on costs of soil-conservation structures, a Section of Cost Records and Analyses was organized in the Division during the latter part of the fiscal year. The purpose of the section is to secure basic data on the unit cost of various kinds of erosion-control work as well as the operating cost of equipment. Cost comparisons of different types of work and of various sizes and kinds of construction units will be valuable to the Service, as well as to other agencies engaged in erosion-control work. A concise schedule for reporting costs has been furnished each demonstration project and Emergency Conservation Work camp under the direction of the Service.

During the year a Section of Engineering Data was set up in the Division to review plans and methods originating in the field. This unit is also engaged in collecting data dealing with the fundamental principles of hydraulics, mechanics, and hydrology as they apply to erosion control. This information will be incorporated in a handbook for field use. Considerable technical material was prepared as a guide for Emergency Conservation Work camp engineers.



On April 1, 10 engineers attached to the Forest Service and the Bureau of Agricultural Engineering were transferred to the Soil Conservation Service.

These men were continued in an inspection and supervisory capacity. Working with, and through the offices of the various regional directors, they facilitated transfers of property from the Forest Service to the Soil Conservation Service, familiarized personnel of the various regional offices with plans, procedure, and contacts of the organization, and assisted in standardizing camp engineering programs.

Engineering staffs of the several field projects supervised the work of the Emergency Conservation Work camps assigned to soil conservation, insofar as mechanical-control work was concerned. They also developed various types of equipment, made surveys and maps where necessary, directed the use of construction and transportation equipment, and cooperated with several State highway departments in perfecting erosion control along highways. A number of original charts were prepared for the design of open channels, weirs, dams, and other structures.

The engineering staff of the Washington office cooperated with engineers of the National Park Service in preparing plans, specifications, estimates of cost, and recommendations for control of shore erosion on national monument lands at Yorktown and Jamestown, Va. They assisted in preparing plans for a complete erosion-control demonstration at the National Training School for Boys in the District of Columbia.

#### DIVISION OF AGRONOMY

Recent developments emphasizing the effectiveness of vegetation as a weapon against soil erosion have greatly increased the importance of agronomy in a balanced plan of erosion control.

The Division of Agronomy directs the integration of vegetative methods with other measures of land treatment in the program of conservation devised for each of the demonstration areas of the Service. This involves the application, coordination, and improvement of such fundamental conservation practices as strip cropping, rotation of crops, reorganization of crop systems, the introduction of new crops, and grazing management. Returning some of the more erodible soils to permanent grazing sod is a very effective means of stopping soil washing and at the same time affords some immediate financial returns to the landowner. The agronomic staff assists not only in the seeding of these permanent pastures but also gives the best available information as to their care and maintenance.

One feature of the agronomic program involves the use of vegetation to stabilize engineering structures such as terraces and terrace outlets. This calls for a study of the adaptability and usefulness of the various plants which may be available in any given locality. The work of directing the application of these practices in conjunction with engineering measures of control took staff members of the Division to most of the project areas during the year. Constructive suggestions for improvement in methods and adaptation have resulted from these inspection trips.

The use of vegetation in controlling wind erosion was discussed at the meeting of Service agronomists attached to the Great Plains project, held during May. Twenty-three agronomists from demonstration projects in the Plains region were in attendance. It was the consensus of opinion that the most practicable solution of the dust-storm problem is to be found in a composite plan calling for a combination of contour cultivation, utilization of crop residues, such as sorghum stalks and small-grain stubble, and level terracing to conserve rainfall.

Members of the Division of Agronomy served on several committees, including one of the Secretary's committees on policies, the drought committee, the dust storm relief committee, and the committee for the preparation of educational material for Emergency Conservation Work camps.

An elementary course in erosion-control agronomy, consisting of 12 general lessons and 3 introductory lessons, was outlined for the enrollees of Emergency Conservation Work camps. These lessons are designed to teach Emergency Conservation Work workers the principles underlying their work on farm-erosion problems. The course is intended to give a better understanding of nature's methods of holding soils in place and should lead to a realization that practically all detrimental erosion is induced, or made worse, by man.

The Division cooperated in the analysis and study of the soil-erosion and soil-management problems of the farm operated by the National Training



School for Boys in the District of Columbia. A preliminary survey was made and plans developed for the installation of a complete soil-conservation demonstration at this institution.

Highly effective results in revegetation of overgrazed slopes have been attained on the Navajo Indian Reservation, both by reduction of grazing and spreading water flowing from adjacent uplands. Also excellent yields of corn have been produced by this simple and inexpensive method of utilizing water that formerly was not only entirely wasted but that cut destructive arroyos in its uncontrolled flight down the valleys.

#### DIVISION OF COOPERATIVE RELATIONS

Just prior to the transfer of the Service to the Department of Agriculture, a Division of Cooperative Relations was created to work out plans for active cooperation with the Extension Service both in Washington and in the field. The Division later was designated as the Division of Cooperative Relations in Extension.

At the close of the year, plans were being outlined for the selection and employment of soil-conservation extension workers jointly by the Soil Conservation Service and the Extension Service. Early stages of the work of the Division involved assistance in the preparation of an expansion program to be followed in connection with the Emergency Conservation Work camps, assistance in formulating articles of association for voluntary soil-conservation associations, the preparation of memoranda of understanding between this Service and the Extension Service, and in cooperation with the Director of Extension the development of policies and plans involving the extension phase of the work in soil conservation. Plans were in course of development at the close of the year for expanding and perfecting the cooperative phases of the national program of erosion control to reach and effectively tie in with the various State and Federal agencies in soil and water conservation.

#### DIVISION OF INFORMATION AND EDUCATION

As the natural and necessary correlary of its demonstration program, the Service placed emphasis during the year upon activities of an informational and educational nature.

The Division of Information and Education carries out these activities on a national scale, and supervises and directs localized educational work performed in the field.

In general, the work of the Division involves the entire scope of public relations and the utilization of every available medium for the dissemination of information pertaining to soil and water conservation. This includes contacts with the press, the use of radio facilities, the preparation and publication of printed material, the preparation and display of exhibits, and similar activities. The Division functions as a center for the clearance of all material intended for eventual presentation to the public.

Immediately upon the transfer of the Service to the Department of Agriculture working relationships were established with the Office of Information of the Department. As a result, the Division now functions in accordance with the customary departmental procedure as an arm of the Office of Information and utilizes to the greatest possible extent the information facilities of the Department.

In the brief period during which the Soil Conservation Service has been a part of the Department the important work of preparing official publications for inclusion in the several departmental series has not progressed beyond the planning stage. A definite publication program will be carried out during the coming year.

Early in the year, the Division undertook the publication of a monthly periodical entitled "The Land: Today and Tomorrow." After the transfer to the Department, this publication was discontinued and plans were made for the issuance of another to be entitled "Soil Conservation." Responsibility for this periodical was placed in an editor assigned specifically to its preparation.

In the establishment and maintenance of contacts with the daily and periodical press, the Division has met with a considerable measure of success. Press releases have been widely used both by the agricultural and metropolitan press. Special articles have been carried by a large number of publications, ranging from scientific journals to popular national magazines and daily newspapers.

Editorial comment upon the work and objectives of the Service has been almost uniformly favorable.

In the utilization of the radio, the Service relied during the greater part of the year upon its projects in the field. Nearly every project was granted free time on one or more broadcasting outlets in its vicinity and sponsored a series of programs. Inclusion of the Service in the Department of Agriculture made available the facilities of the Radio Service of the Office of Information, and steps were taken at once to participate in departmental programs directed by that Office.

Exhibits of various kinds were prepared and displayed by the several projects of the Service at State and county fairs, agricultural meetings, and similar gatherings during the year. Exhibit work is now being conducted in cooperation with the Division of Exhibits of the Extension Service in the interest of coordinating this activity of the Service with similar activities on the part of other departmental agencies.

Toward the close of the year, initial steps toward the production of a soil-conservation motion picture were taken by the Division in cooperation with the Division of Motion Pictures. A member of the Service staff accompanied a camera party from the Division of Motion Pictures on a swing through the dust-storm area with a view to obtaining wind-erosion and dust-storm pictures suitable for inclusion in a soil-conservation film.

Toward the close of the year, the Division undertook a reorganization of the photographic system of the Service with a view to centralizing responsibility and organizing photographic operations in the interests of efficiency and economy.

Likewise, toward the close of the year, the Division assumed responsibility for the procurement of printing and binding services for the entire organization.

### INVESTIGATION AND RESEARCH

The field of research was established in a general way by the Soil Conservation Act and by the Secretary of Agriculture's memorandum of March 27, 1935.

Paragraph (1), Public No. 46, Seventy-fourth Congress, an act to provide for the protection of land resources against soil erosion, and for other purposes, provides:

To conduct surveys, investigations, and research relating to the character of soil erosion and the preventive measures needed; to publish the results of any such surveys, investigations, or research; to disseminate information concerning such methods, and to conduct demonstrational projects in areas subject to erosion by wind or water.

A memorandum of the Secretary of Agriculture, dated March 27, 1935, provides for the consolidation of soil-erosion work in the Department of Agriculture:

The Soil Erosion Service has now been established in the Department of Agriculture. This organization will operate as a separate unit of the Department, under direction of the Secretary, and will include the soil erosion investigational, service and control work in the Department, as follows: \* \* \* The soil erosion investigations and regional experiment stations at present conducted by the Bureau of Chemistry and Soils and the Bureau of Agricultural Engineering, under allotments from the Departmental appropriation for Soil Erosion Investigations. \* \* \* The erosion control nurseries and activities of the Bureau of Plant Industry dealing therewith, \* \* \*.

The foregoing authority indicates that the research work of the Soil Conservation Service should be directed toward (1) the determination of the character of soil erosion, and (2) the development of preventive measures.

The program of research to carry out these purposes is broken down into special phases of work assigned to particular sections to facilitate effective work and to make use of specialists within their representative fields. Final establishment of all necessary divisions will not be made, however, until the general program of research has been formulated. Instead, the research work, or a considerable part of it, will be carried out essentially on a project basis.

The work is divided along the following broadly defined lines: (1) Erosion investigations on agricultural lands; (2) climate and geomorphological studies; (3) watershed and hydrologic studies; and (4) sedimentation and hydraulic studies.

#### SOIL-EROSION INVESTIGATIONS

The soil-erosion investigations of the Bureaus of Chemistry and Soils and Agricultural Engineering, which centered in 10 erosion experiment stations



in as many different physiographic regions of the country, were transferred to the Soil Conservation Service effective April 1, 1935. This work has been extended in the meantime by the establishment of similar stations at State College, Pa., at Ithaca, N. Y., and at Mexican Springs, N. Mex., making a total of 13 erosion experiment stations. Approximately 250,000,000 acres of land are served to a greater or lesser extent by these units. Others, it is hoped, may be established in the near future in regions greatly in need of more definite information on methods of procedure in soil conservation. As these stations reach out into the interregional areas, with substations and field studies to take care of the problems of secondary regions upon which it will never be economically feasible to establish erosion stations, the immediate area served by these central stations will become progressively greater.

#### REGIONAL EROSION PROBLEMS

The first and most important responsibility of the staff of a newly established erosion experiment station is a careful study of the soil-conservation problems of the immediate region it is designed to serve.

The generalized erosion survey of the entire country undertaken during the past year offered an excellent opportunity for studies of this nature. Members of the staff of practically all the erosion experiment stations assisted in this work, especially in the regions represented by their particular stations. This helped very materially in familiarizing those engaged in research with the immediate problems of the region.

The survey of the Palouse country in the Pacific Northwest showed that 21,000,000 acres of this important area are subject to severe erosion, of which more than 7,000,000 acres are being very seriously damaged. Studies and measurements made at the erosion station indicate that 3,500,000 acres in eastern Washington, Oregon, and western Idaho are losing from 8 to 30 tons per acre of productive topsoil annually. It has been demonstrated at the erosion station that these losses can be controlled to a very definite degree by the use of proper systems of cultivation and cropping.

Reference is also made to the survey studies of the Bethany station serving the Missouri-Iowa area composed largely of Shelby, Grundy, and Lindley soils. Depending on the section of the general region involved, severe erosion was found to affect from 8 to 36 percent of the area, moderate erosion from 9 to 10 percent, and slight erosion from 16 to 26 percent. In respect to gullying, 35 to 43 percent of the area is concerned with the serious type, and 4 to 13 percent with the moderate type. In contrast with the State of Missouri, with about 42 percent of its entire area seriously affected by sheet erosion, the Shelby soil region is seriously affected over about 63 to 75 percent of its area.

Census figures may assist somewhat in pointing out the primary cause of this unusual condition in this section. In the Shelby soil area farms average about 150 acres in size. On these, about 50 percent of the land is cropped, 45 percent is in pasture, very frequently overgrazed, and only a little over 1 percent is in timber or wood lots. Furthermore, on the cropped land nearly 45 percent is in corn, about 20 percent in small grains, and an average of about 35 percent in permanent meadow and legumes. From this it would appear that the high corn acreage is an important factor in the development of severe erosion in this area. This conclusion is supported by the results already obtained from investigational work now under way. The cultivation of corn and other clean-tilled crops in regions where improper cultural methods are combined with excessive slopes is consistently found to be an important cause of excessive soil losses.

As a result of the erosion survey it was found that the work of Temple Soil Erosion Station, Tex., is applicable to more than 15,000,000 acres in the Blackland section of Texas alone. To this should be added the dissociated Black Belt of Mississippi and Alabama, although up to the present time it has not been found possible to do any erosion-prevention work in this latter section.

The Blackland section in Texas consists of about 9,500,000 acres of crop land and 5,500,000 acres of pasture. Of the former, more than 7,500,000 acres need protection against erosion; nearly 550,000 acres have already become too poor to justify costly control measures. It is estimated that nearly 3,000,000 acres of the pasture land in this section also needs improvement and protection. Similar general studies in the other regions served by the various soil erosion experiment stations have served to fix more definitely in the minds of staff members the problems confronted in the field.



## STUDIES OF METHODOLOGY AND TECHNIC IN EROSION CONTROL

In a new field of investigation such as erosion control, involving a great complication of conditions under which hydraulic measurements of one kind or another must be made, it is natural to find a dearth of equipment and methods. In order to establish the experimental work in the field on a fundamentally accurate basis, therefore, it has been necessary, first of all, to develop hydraulic equipment and methods of procedure to meet the needs of prescribed experiments.

Notable progress has been made during the past year in several phases of this work, especially in the modification and calibration of divisors with which to reduce to sampling proportions the widely fluctuating volumes of run-off which carry varying loads of suspended materials. In the setting up of such equipment in the field it is important to develop a system of screens which will serve to protect the action of the divisor against quantities of roots and trash of one kind or another which come down with the run-off. Most of this work has involved preliminary studies with clear water followed by silt- and trash-laden water to simulate field conditions as nearly as possible. As soon as these equipment tests are completed in the laboratory, specifications are immediately furnished the field station, wherever desired, for study under full-field conditions.

In connection with this phase of the work the officials of the Bureau of Standards have cooperated by making space available in their well-equipped hydraulic laboratory.

## SOIL AND WATER LOSSES

At all the erosion stations studies are under way to determine the effect of length and degree of slope, cover, cultivation, organic matter, and a number of other factors on soil and water losses. The relation of plant cover in this connection is clear. While larger plots and replications of treatments will be necessary to place these relations on a statistically accurate basis and so make them more readily applicable to general field conditions, the differences developed on the single 1/100-acre control plots at the various stations are so striking as to justify brief review. Insofar as the relation of vegetation to erosion control is concerned, however, they are so generally similar from station to station that a brief tabular review of the work of the Guthrie Station through a 5-year period will suffice. This is given in table 8.

TABLE 8.—*Relation of type of vegetation to run-off and erosion on Vernon fine sandy loam, Red Plains Soil Erosion Station, Guthrie, Okla.—5-year summary, 1930-34*<sup>1</sup>

[Average rainfall: Control plots, 33.39 inches; woods plots, 33 inches]

Crop and/or treatment	Slope	Plot years	Run-off	Erosion per acre
	Percent	Number	Percent	Tons
Cultivated crop (cotton).....	7.7	5	15.4	25.4
Small grain (wheat grown in rotation).....	7.7	5	14.5	1.7
Hay (sweetclover grown in rotation).....	7.7	5	8.3	.62
Woods (burned off).....	5.2	5	5.4	.19
Bermuda sod.....	7.7	5	1.4	.04
Woods (virgin).....	5.2	5	.2	.02

<sup>1</sup> These plots established as strips 6 feet wide and 72.6 feet long on the slopes indicated, in such manner, that all soil and water losses are caught at the base of the lower end and accurately measured.

Results shown in table 8 indicate that the protection afforded by close-growing vegetation against soil and water losses under natural conditions in the field is effective. The average soil loss under the cultivated crop, cotton, is about 625 times as great as under a grass cover, while the percentage of run-off of rainfall is reduced from 15.4 under cotton to 1.4 under grass.

During the last half of 1934, 72 tons of soil per acre were lost from the fallow plot and 40 tons per acre from the plot in corn at the La Crosse, Wis., station on Clinton silt loam with a slope of 12 percent. Over the same period the mixed clover and timothy plot lost 0.4 tons per acre. Relations of this type involving control of soil and water losses at source should be kept

strongly in mind in the development of any comprehensive plan of flood control.

#### COST AND RATE OF SOIL REMOVAL

Given a definite condition of erosion, the cost and rate of renewing the soil depends to a very great extent on the type of soil involved. Where good soil materials are found in the subsoil, when it appears at the surface in the progressive course of erosion, as in the Cecil or the Marshall types, the renewal of a productive soil layer can be comparatively rapid, involving, of course, the judicious use of grasses, legumes, etc. Where exposures of such essentially geological materials are involved as occur in the form of shales or marls under the Muskingum or Houston soils, productivity renewal will be very slow. The rebuilding of our soils, already disturbed to varying degrees by erosion, is one of the most important problems confronting the Service and should receive a great amount of attention in the near future. Studies are showing more and more clearly the pronounced effect of erosion not only upon the yield of crops but on quality of the product as well. Under conditions of particularly difficult exposure great benefit has been derived from mulching with forest litter, straw, or other material, both in effecting improved germination of seed and in the protection of the surface against washing through the early stages of plant-cover development.

#### RELATION OF PROPER ROTATIONS TO EROSION CONTROL

The development and use of a proper rotation is a matter of great importance in control of erosion. The fundamental factor is the manner in which the cultivated crops are worked in. Thus, in some studies the degree of erosion under cultivated crops such as corn or cotton in a one-crop system has been much more severe than where the crops appear in a well-ordered rotation. Cultivated crops should be followed by close-growing covers, or the soil should be protected through the winter by temporary covers.

The approximate degree of soil exposure to erosion following the use of a given rotation, has been calculated at the Bethany, Mo., station. The calculated "protection" value is based entirely on soil losses under various crops or as a result of field operations which accompany those crops through the several seasons. The entire amount of protection credited to the 3-year rotation of northern Missouri—corn, wheat, and clover—is found to amount to 80 percent. A similar treatment of the corn-oats-clover rotation gives essentially the same figure, whereas a corn-oats-wheat-clover rotation shows 74 percent of full protection; corn-oats-clover, 68 percent; and continuous corn only about 27 percent. The determination of the relation between soil conservation and important rotations in common use in other parts of the country is most desirable. These relations were developed against the average local rainfall as far back as the record is available.

It has been calculated at the Bethany Station that while 7 inches or plow depth of the surface soil will be lost in about 15 years under continuous corn, nearly 78 years will be required to remove the same amount of soil under a rotation of corn, wheat, and clover. Careful studies also indicate that in comparison with continuous culture, corn land loses much less soil when it is in a well-planned rotation. Similar results have been obtained at the Guthrie and other stations with such a rotation as cotton, wheat, and sweetclover. Likewise on the Marshall silt loam, the continuous growing of corn on normal (uneroded) soil caused a soil loss of 67 tons per acre through the last 30-month or 3-crop-year period; rotated with oats and clover the loss was reduced to 27 tons, while covers of alfalfa or bluegrass reduced it to about 1 ton. Actual losses of water through the same period under the three conditions were 8, 6, and 3 inches, respectively. To show what might be regarded as the effect of erosion on erosion continuous corn was found to have induced a total soil loss of 103 tons from exposed subsoil in contrast with the loss of 67 tons from normal soil or exposed soil.

#### IMPROVEMENT OF SURFACE IMPOUNDAGE

All water falling on the soil and not taken up by it within a limited time is free to concentrate and start erosion, depending on the degree of slope and conditions of soil exposure involved. It is important, therefore, that every effort



be made to improve not only conditions affecting the rate of infiltration of water into the soil, but also those which will increase impoundage at the surface and prolong the period of seepage. This is being done by a number of practical operations in the field, most important of which is contouring.

#### CONTOUR TILLAGE

In contrast with running rows up and down the slope—a practice responsible in the past for some of the worst conditions of erosion on cultivated land—operations of one type or another on the contour have been found of tremendous benefit in erosion control and moisture conservation especially in improving surface impoundage. In the course of  $2\frac{1}{2}$  years of test on Marshall silt loam in Iowa no run-off whatever has been noted from corn plantings carefully listed on the contour, whereas heavy losses have developed from corn planted in rows running up and down the slope. Of special interest in this connection is a basin type of lister under trial at the Clarinda and Hays Stations. This implement builds small earthen dams mechanically at regular intervals of predetermined length in the channels (inter-row furrows), thereby creating short basins 3 to 6 feet in length. This equipment appears to be a great improvement over that which produces a continuous furrow channel, since the development of short basins permits of less precise operation in relation to the contour, a point of considerable importance in ordinary field routine.

#### HOLE-DIGGING MACHINE

Satisfactory results have been obtained during the year with the hole-digging machine. This is, of course, a direct effort at increasing surface impoundage whether from rain or snow. At the Guthrie, Okla., station, wheat land treated with the machine showed an increase of  $2\frac{1}{2}$  to 3 percent in moisture content as compared with untreated land. Likewise, plots planted to cotton and treated with the hole-digging machine lost appreciably less soil and water, in the form of wash-off and run-off, than control plots not so treated. Practical farmers have reported satisfactory results with the machine on the Las Posas erosion demonstration project near Santa Paula, Calif. Studies on hole digging are being continued.

#### CONTOUR WATER FURROWS IN PASTURES

At a number of the stations, work has been started in the contouring of pastures with a low type of terrace. The structure consists of little more than a formed ridge, set up by a few turns of the plow, and a water furrow. Laid out at 1-foot vertical intervals on an abandoned and gullied field of 5- to 8-percent slope at the Tyler, Tex., station and subsequently seeded to Dallis grass, bur clover and Lespedeza sericea and set to Bermuda grass, such contour ridges have been remarkably effective in preventing soil and water losses and in improving the density and growth of cover.

#### LEVEL TERRACES

Level terraces with or without closed ends are proving decidedly effective, under conditions of low rainfall, in slowing down or preventing run-off entirely. Notable increases in crop development, resulting from improved moisture conditions, have been observed on plots terraced in this manner. This operation and all others having to do with increasing surface impoundage must be considered very carefully in relation to the ability of the soil to take up the water stored in one way or another at the surface.

#### INFILTRATION STUDIES

As pointed out, the capacity of a given soil to take up water falling on or passing over its surface is an important factor in determining its susceptibility to erosion. It is highly important, therefore, to increase by every means possible, the rate or capacity of a soil to take up water. This is true not only from the standpoint of conserving it for crop use, preventing erosion and improving ground-water conditions in general, but also for the direct effect which flash run-off exerts on the critical problem of flood control.

Work in this field is under way at several stations with a special type of lysimeter which permits the measurement of soil and water losses from the



surface as well as of the percolate that passes through an undisturbed core of soil of given length. Opportunity is thus provided for the study of a variety of soil treatments. By using such lysimeters in a series of fallow treatments of Marshall silt loam, 3 of which received organic matter and 3 did not, the run-off was decreased by more than 7 percent, the percolate increased by more than 35 percent, and the evaporation decreased by 3.8 percent in consequence of the organic-matter treatment. A similar arrangement under a crop of corn showed a decrease of 30 percent in the run-off, an increase of 98 percent in the percolate, and an increase of 5 percent in evaporation and transpiration as a result of the treatment. The whole problem of the relation of organic matter, whether in the form of farmyard manure, green manure, straw, root, or other crop residues, should be investigated completely for its relation to erosion control. Studies on the Marshall soil under field conditions have given substantial confirmation of the influence of organic matter in this same way, whether with the use of farmyard manure or the plowing under of sweetclover. In a similar way the turning under of a 15-ton crop per acre of sweetclover on Palouse silt loam reduced the soil loss from 22 tons to 1.1 tons per acre.

Infiltration studies are of particular value in comparing the behavior of soil types, within certain definite limits. Identical studies on the permeable Marshall and the relatively impermeable Shelby silt loams have shown that the former is able to take up 10 times as much water as the latter. Naturally this fundamental difference should have a very definite influence on the type and design of erosion-control methods planned for effective and efficient use in the field on these two highly important agricultural soils. Field trials, however, on soils of the Pacific Northwest and of the bean district of Southern California indicate beneficial results from subsoilers of the "chiseling" type.

As might be expected, the benefit of subsoiling from the standpoint of improving the infiltration capacity of a soil will depend to a large extent on the physical character of the soil material under treatment. In trials on Vernon soils at the Guthrie station it was found that the plastic clay flowed back together too readily for any lasting benefit from such treatment. A similar result has been obtained from studies on the plastic subsoil of the more important Houston clay at the Temple station.

It is hoped in the near future to carry on a thorough study of all of the more important soil types in all parts of the country from this standpoint, through the use of portable equipment now being developed for the purpose.

#### STRIP CROPPING

Strip cropping involves the laying out of strips of definite width along the contour of the land for alternate use of cultivated and close-growing or "filter" crops. The principle involves the shortening of exposed slopes just as in the case of terracing. The close-growing crop serves to spread and slow up the flow of surface water coming from the cultivated strip and to cause the deposition of the greater part of any soil that may be moving down the slope with it, also to increase absorption of the water itself.

The width of the strips and consequently the proportion of the area that may be devoted to cultivated and protective crops, respectively, depend not only on the soil involved but also on the degree and regularity of the slope, the extent to which the area already has been eroded, and the care to be exercised in establishing, cultivating, and maintaining the strips and on limitations with respect to land available for a balanced economic farm unit. It is apparent that as the degree of slope increases so must the width of the protective strip be increased at the expense of the area available for the cultivated crop. It is also apparent that this may be varied either way for certain soils, according to their susceptibility to the infiltration of surface water. Work in the Tyler, Tex., area is emphasizing the effectiveness of narrower strips which center around balk strips seeded to vetch or other close-growing crops, and broken out to form drainage furrows leading to natural, protected drainage ways along the slope.

It is particularly important that the strips be laid out carefully on the contour or deviate from the contour only to a definitely controlled degree according to conditions of soil or topography; that all operations on the cultivated areas be contoured with the strip basin in order to develop a maximum erosion-protection capacity; and that short, or point rows be avoided so far as possible by taking up irregularities between strips with the closely seeded crop.

At the Bethany (Mo.) station it has been found convenient and desirable to seed the irregular tops and bases of the slopes with thick-growing crops such as alfalfa or mixtures of clover and timothy which can occupy such areas without disturbance for several seasons if desired by widening the thickly planted strips at approximate places.

A recent review of the possibilities of strip cropping in the several regions served by the experiment stations indicates a considerable potential value for this practice as a measure of erosion control on slopes up to 8 or 10 percent. As already suggested, however, this will vary considerably from soil to soil and from worker to worker. On the Houston soil of Texas, for instance, best results are being obtained on slopes of 2 to 4 percent. At the Temple station during the first 6 months of 1935 oat strips with resultant stubble held the loss of soil to 2.61 tons per acre whereas the cultivated unstripped area lost soil at the rate of 85.28 tons, or 32 to 1 by comparison. Alfalfa strips on 3- to 4-percent slopes at the Guthrie station have proved very effective. As a newer phase of the work, combinations of strip cropping with terraces of either normal or modified cross section are giving particularly promising results. This practice should be emphasized in studies of this nature, for a number of physical reasons.

#### TERRACING

Climatic and soil factors greatly influence the proper construction, maintenance, and operation of terraces. On this account terrace design is being studied at all stations, especially as it pertains to length, grade, and vertical spacing. Vertical spacing, for example, may vary all the way from 6 inches at the Temple station to 35 feet at the Pullman station—at least under experimental conditions.

#### TERRACE GRADES

While level terraces may be found advantageous under arid or semiarid conditions, especially for the purpose of conserving water, under humid conditions they are uniformly impracticable on account of pondage and drowning of crops in the channel, excessive capacity required, and excessive cost of proper construction and maintenance. A slight grade is usually required under normal conditions of rainfall, therefore, and studies now under way usually point to superior results from the use of a variable grade.

#### LENGTH OF TERRACES

Since soil losses tend to increase with terrace length, emphasis is placed on the use of the shorter types. However, costs of construction and maintenance, and the inconvenience in field operation are increased as the length is shortened so that in practice it becomes necessary to make the length conform with these factors as well as with the topography of the area under consideration. In the central piedmont region, terraces having uniform grades on a 10-percent slope with a 4-foot vertical spacing gave entire satisfaction up to lengths of 2,000 feet.

#### TERRACE SPACING

In a similar way increased spacing of terraces on cultivated land tends to increase soil losses. This specification, therefore, must be carefully adjusted to requirements of soil, degree of slope, and a number of other factors. Sufficient data are not yet available upon which to develop categorical values for the maximum degree of slope that may be terraced according to the soils or land-use practices involved in a particular climatological region. At the Bethany station it was found that with terrace spacings of 3, 5, and 7 feet, 0.49 ton, 0.98 ton, and 1.64 tons of soils were discharged at the ends of the respective terrace channels. These values represent averages for 3-year periods.

#### TERRACE MAINTENANCE

Terrace maintenance is of prime importance to the usefulness and efficiency of this method of erosion control. The common practice of moving accumulated fill from the terrace channel to the crest causes a part of the fill material to pass on down the slope during the course of the season. Quite recently the use of a two-way plow for moving channel fill has been placed under test at a number of stations. By turning the furrow up hill in the plowing operation



and reversing at the terrace channel to build up the ridge, there is considerable possibility that this difficulty may be overcome. This practice may also prove effective in moving back up the slope some of the soil mass that is constantly washing downward, especially under cultivated conditions.

Terracing is widely recognized as a most important phase of soil-conservation work. It is apparent, however, that many important details must be worked out before it can be definitely stated where terraces may best be used and how they should be constructed and maintained. Among these is the proper combination and adjustment of terraces with the rotation of crops so that the maximum benefit of plant cover may be secured. With this in mind, considerable thought is being given to studies of terracing and strip-cropping combinations. In evaluating the actual efficiency of terracing as a measure of erosion control it is necessary to consider the amount of soil moving down the slope between terraces and lodging in the channel, just as it is necessary to consider the deposition and accumulation of soil in the strips of close-growing crops used in strip cropping. Information of considerable value along this line should be forthcoming from studies on soil-movement lines when they have been continued through several more years of measurement.

#### GULLY, CHANNEL, AND OUTLET CONTROL

The importance of vegetation in gully and channel control is receiving continually greater recognition as a valuable supplement to strip cropping and as an independent control factor in washes and terrace outlets. It is essential that new vegetation and mechanical structures in gullies or outlet channels should be protected as far as possible by the diversion of all drainage waters from the gully head. On badly gullied hillsides it is frequently possible to obtain protection by running a terrace along the crest of the eroded area. This intercepts the run-off water from higher slopes and permits the area below to be treated more or less as a separate unit. Once vegetation is established, however, it should be fully protected against overgrazing or other injury.

The design and construction of check dams in gully control is dependent primarily on the maximum rate of flow anticipated, which in turn depends on the size, slope, and vegetative cover of the watershed area. Under average conditions it is preferable to build low structures for stabilization of the gully bottom rather than to attempt to reclaim the entire affected area. By holding deposits of fertile soil and maintaining favorable moisture conditions, these structures have been extremely beneficial in promoting plant growth.

Broad, shallow terrace-outlet ditches, protected with underground checks (usually consisting of creosoted 1- by 8-inch boards on edge) and grassed surfaces, have been effective at a number of erosion experiment stations. Observations at the Bethany Station indicate that the maximum depth of water flow in such outlets should not exceed 8 inches on uniform slopes of 5 to 10 percent. While much progress has been recorded in the design and construction of gully and terrace outlets, a great many practical problems remain to be solved before a maximum of efficiency can be obtained.

#### FARM-MACHINERY PROBLEMS

The construction, maintenance, and cultivation of terraces present the most important farm-machinery problems of soil-conservation work. Much improvement has been made during the past 2 years in the heavier types of machinery employed in terrace construction, but further study will be necessary to determine the most economical use of this heavy-type machinery under practical farm conditions.

For example, contour operations on a steep, terraced field often strain certain parts of machinery, necessitating additional strength in those parts and greater flexibility in the whole unit. The hole-digging machine and the basin lister are notable examples of machinery designed for a specific purpose, and there is little question of the great need for further development in the field of machinery.

#### WIND EROSION

Although vast midwestern areas are periodically affected by wind erosion, only a limited amount of study has been given this problem at the Hays Station, which is considerably removed from the more severely affected regions. Most attention has been given to the relation between soil furrowing



or roughing and wind-erosion control. Repeated listings or harrowings break down the soil structure and expose the moisture to loss by evaporation. "Blow" conditions develop on such fields if the dry winds continue too long.

In the Palouse section of the Pacific Northwest wind erosion develops into a serious problem in any part of the area where soil and moisture conditions are conducive to drifting. Low precipitation and sandy textured soils, such as are found over a large area in east-central Washington, are conducive to severe types of wind erosion since these are associated with scant plant cover and low organic matter. Experiments and observations at the Pullman Station and on outlying areas indicate that tillage methods which leave the surface cloddy are of great assistance, although a minimum of tillage is to be desired. Disking wheat stubble into topsoil has shown beneficial results. Crested wheat-grass and slender wheatgrass seem to be promising plants for reseeding and reclaiming "blow" land in this section.

It is hoped that in the near future the Service may be able to establish additional erosion experiment stations in the Midwest for the specific study of the many problems involved in wind-erosion control.

### CLIMATIC AND PHYSIOGRAPHIC STUDIES

In a memorandum to the Soil Erosion Service, dated April 26, 1934, the land committee of the Science Advisory Board (created by President Roosevelt) calls attention to the urgent need of undertaking, as a unit, research dealing with surface, soil, and climate.

Association of effort is indicated both because the problems are interlocking, and because they must be examined under a coordinated plan in the various sections of the country with continued comparison of results between sections. Expressed in their own terms, these inquiries are concerned with some of the most important and least recognized problems of earth science. Without altering these objectives the proposed investigations are also applicable as fundamentals in land utilization.

The most important physical crisis in land use is soil erosion, a term used to include various wastages of land surface as the result of human exploitation. Huge areas in the United States are in varying degree in such a crisis, which the Soil Erosion Service has been organized to meet. A part of the general program being developed by the Science Advisory Board is basic to a permanent plan of soil-erosion management, and that part is here briefly summarized, as a specific subprogram fundamental to erosion control.

The setting up of such a program of investigation involves two groupings, one of climatic problems, the other of soil-slope studies, with continual contact between the two groups necessary.

In the climatologic group, ecology and probably soil science should be represented. Its task will be to combine conversion of instrumental data and field observations. Field work will be necessary, first to check up apparently anomalous instrumental records, secondly, to interpolate from vegetational data and soil profiles where records are wanting. The grazing lands of the West and their agricultural margins demand such examination first of all. The Great Plains, in terms of land economy one of the two most critical land regions of the United States, involve a complex of problems all climatically conditioned. The Southwest over large areas is in acute process or danger of destruction of surface and also urgently requires analysis of the climatic condition.

The groups concerned with soil-surface relations deal with a geomorphologic problem involving exact surveying. The selection of localities for study should follow careful reconnaissance to locate representative undisturbed areas in as close proximity as possible to erosion experiment plots.

In the field of earth science, objectives of inquiry can be stated in terms of experience at hand and ends desired. The work itself cannot be laid out in advance in every detail. Direction of inquiry can be agreed on, but progress in discovery will itself mean change of direction. Plans are modified recurrently by the results of observation. This program therefore provides only a systematic beginning along certain well-defined lines of observation. It should be redefined from time to time as promising leads are opened up. As long as the relation of climate, soil, and slope to each other and to human use are of interest, there will be occasion to redefine position and redirect the course of investigation.

### RESEARCH PROGRAM IN CLIMATE AND GEOMORPHOLOGY

Pursuant to the recommendations of the Science Advisory Board, the work in the Section of Climatic and Physiographic Research is undertaken along four lines of research in the fields of climate, ecology, geomorphology, and erosion history.

1. The purpose of climatic research is to determine the general role of climate in its various manifestations on the processes initiating soil erosion.

2. The purpose of ecological research is to determine the role of plant communities and their migration and succession in the problem of soil erosion and its control.

3. The purpose of geomorphic research is to determine by detailed survey in type areas the complexes of land forms and processes of denudation and erosion which bring about regional differences in soil wastage.

4. The purpose of research in erosion history is to determine from the study of old maps, documents, and records, the original character of the various natural landscapes investigated in the field for the purpose of establishing datum points for the determination of climatic change, of the extent and rate of soil wastage, and deterioration of the plant cover.

These four lines of research must be undertaken as a single integrated unit. The geomorphological investigations will be carried on largely in the field and laboratory. These will be reinforced by ecologic studies and will throw light on climatic change through physiographic evidence and through analysis of fossil pollen which may be found embodied in peat or marl deposits. The climatologic investigations will facilitate the interpretation of the processes of erosion and denudation which the geomorphists investigate in the field. The studies of erosion history will obviously be made for the purpose of establishing a basis for measuring the extent of climatic as well as ecologic and geomorphological changes. Synthesis cannot be undertaken until a large amount of detailed field work and library and statistical work shall have been completed. Thus, it is desirable to initiate work along all fronts simultaneously.

Geomorphological field work has been under way in the Polacca Wash in northeastern Arizona for more than a year. A preliminary report has already been submitted. It is desired that at least five similar field parties be set to work in strategic locations in widely separated erosion-type areas on the stable soils, as well as on those that are actively eroding. There is urgent need for an investigation of mass movement of soils probably beginning in California, where the process was first recognized, and in addition for investigations of induced surface wastage, such as sheet wash, rill washing, and gullyng, as developed in the piedmont area.

#### WATERSHED AND HYDROLOGIC STUDIES

The operations of the Soil Conservation Service offer an unequalled opportunity for accumulation of experimental data and for studies of engineering problems relating to watershed conservation, water supply, flood control, and run-off as affected by land-use and erosion-control practices.

During the year, preliminary plans were made for the eventual study of 16 watersheds representative of typical regions of the United States. Where possible, two comparable watersheds, approximating 5,000 acres each, will be used in each region, one to be the medium for erosion-control practices and the other to remain essentially in its original state to serve as an integrator of climatic factors.

As a part of these experiments small watersheds ranging from about 5 to 15 acres will be used for erosion-control practices adapted to the particular region. Intermediate watersheds ranging from 30 to 4,000 acres will be used to determine the relation between size of watershed and rate of run-off and erosion under different amounts, durations and intensities of rainfall.

The principal objectives of these studies are to determine the effect of scientific land-use and erosion-control practices on flood control and the conservation of water for crops and water supply. The studies also will determine the amount of run-off, under different amounts and intensities of rainfall for watersheds of different configuration, size, soil, topography, cover, underground conditions, land-use and erosion-control practices.

The general plan of study consists (1) of the evaluation of all important factors by carefully conducted experimental studies and (2) of tracing the operation of such factors from small to large watersheds. None of these investigations was beyond the planning stage at the close of the year.

#### SEDIMENTATION AND HYDRAULICS

The general objective of the work of the Division of Sedimentation is to establish necessary additional information concerning actual circumstances, and processes and rates of debris transportation and deposit, in order to afford a more adequate factual basis for planning and evaluating of erosion- and silt-control practices.

Working plans thus far developed and presented for approval focus investigation activity along four major related lines, as follows:

(1) Nation-wide investigation of American reservoirs to provide an accurate record of reservoir sedimentation and rate of storage depletion. This work involves reconnaissance examination and report on all important reservoirs of the country, State by State, as a basis of general information; and the informed selection of significant reservoirs for detailed study. The detailed reservoir surveys are planned to establish information on the factors involved in silting, the rates of silting as related to different soil, slope, and climatic conditions, and to correlate these results with land-use and erosion-control practices in watershed areas.



(2) Investigation of conditions and processes of sedimentation in stream channels and valleys, resulting from accelerated erosion of tributary upland areas. The object is to determine the character, magnitude, and principles governing the effects of accelerated upland erosion on lowland channels, soils, and flood manifestations.

(3) Hydraulic laboratory investigations affecting the energetics of debris-laden water, the wear of debris in course of stream transportation, specific field-construction problems, development of new erosion and flowage-control practices, and experimental application of results to full-scale engineering problems in the field. The project includes development of new, special-purpose measuring and sampling apparatus and field surveys of prototype conditions that present the problems to be investigated by model experimentation in the laboratory.

(4) Investigation of bed-load transportation in natural streams by direct measurement with new type installations to be placed at selected sites on representative streams in different type regions of the country. It is proposed to establish for the first time a true measurement of total stream load, which is an essential factor in erosion- and stream-control problems. The study is to include determination of the character, volume, and related hydraulic and energetic determinants of bed-load transportation to substitute for the previous basis of evaluation of total load by estimate from measurement of its indeterminate fraction carried in suspension.

Field work during the fiscal year was limited to field investigations of reservoir silting under project 1. Office work included detailed planning of projects 2 and 4 in the Washington office and of project 3 in the offices of the collaborators at California Institute of Technology under cooperative arrangements made during the year.

The general project of reservoir investigations was initiated July 15, 1934, with a general survey of previous work in this field, followed by further development of the problem and optimum methods of study, and with selection and organization of personnel for at least three field parties to make a detailed reservoir survey in the southeastern, southern Great Plains, and southwestern type areas of the country. Subsequent extensions of the work to the northeastern and northwestern parts of the country are contemplated.

A general field reconnaissance of the three southerly type areas was made after visits to 87 reservoirs in North Carolina, South Carolina, Georgia, Alabama, Texas, New Mexico, Arizona, and California. In connection with this preliminary work, detailed studies were made of the municipal reservoirs of Greensboro and High Point, N. C., Spartanburg, S. C., and Rogers, Tex. The method and apparatus for direct measurement of silt depth, now used extensively in similar work, were developed during this preliminary study.

Field parties of technical men began work in their respective fields in late December in the Southwest, and early in January in the Great Plains and Southeast areas. The results obtained by each party appear in the accounts of detailed reservoir surveys in their respective areas during the remainder of the fiscal year as given in the following section of this report.

The Elephant Butte survey was made in cooperation with the United States Bureau of Reclamation. Field work was directed from the Albuquerque regional office.

In addition to the foregoing items of the field program, an original capacity survey of Boulder Reservoir, Colorado River, was undertaken by the Service in cooperation with the United States Bureau of Reclamation and the Coast and Geodetic Survey. Detailed topographic mapping of certain flatter areas of the reservoir basin and other necessary observations were undertaken with the aid of personnel of the Bureau of Reclamation, directed by an engineer of that Bureau. The aerial photography, detailed control surveys, stereoplanigraphic contouring, and assemblage of the final complete map of the reservoir are being done under contract with a commercial concern.

This survey was actively prosecuted during the last 4 months of the fiscal year. During this period the work accomplished included the primary control of the reservoir area by the Coast and Geodetic Survey, aerial photography over the reservoir basin and secondary control to Gregg's Ferry, and detailed topographic mapping of Virgin and Mudd Creek Valleys, detailed sounding in the head of the reservoir to Pierces Ferry, and observations of variation of water levels with variable discharge and wind conditions at four stations located at the dam, at the head of Boulder Canyon, at Gregg's Ferry, and at Pierces Ferry, by the United States Bureau of Reclamation.



## SUMMARY OF RESULTS

Table 9 summarizes the data resulting from detailed reservoir surveys by field parties of the Soil Conservation Service to June 30, 1935. The last two columns of the table emphasize the wide-spread prevalence of serious rates of storage depletion and the critical extent of cumulative encroachment of silting upon the total capacity of even the largest reservoirs in a comparatively brief period.

TABLE 9.—*Reservoirs surveyed by Soil Conservation Service, 1935*

Reservoir	Location	Period	Age	Original capacity	Storage per square mile of drainage area	Annual silt accumulation per 100 square miles of drainage area	Annual depletion of storage	Total depletion of storage to date of survey
			Years	Acre-feet	Acre-feet	Acre-feet	Per-cent	Per-cent
Lake Michie.....	Durham, N. C..	April 1926-January 1935.	8.75	13,457	79.16	27.69	0.35	3.07
University Lake..	Chapel Hill, N. C.	June 1932-April 1935.	2.92	2,076	76.92	87.9	1.13	3.29
Greensboro.....	Greensboro, N. C.	February 1923-August 1934.	11.5	2,870	39.80	31.3	.78	9.05
High Point.....	High Point, N. C.	August 1927-August 1934.	7	4,220	72	60.8	.84	5.87
Lake Concord....	Concord, N. C..	March 1925-May 1935.	10.16	1,179	310.49	200.8	.65	6.57
Spartanburg.....	Spartanburg, S. C.	May 1926-July 1934.	8.17	2,700	29.3	62	2.1	17.15
Lloyd Shoals (Ocmulgee River).	Jackson, Ga.....	December 1910-March 1935.	24.33	107,702	78.24	26.5	.34	14.58
Rogers.....	Rogers, Tex.....	September 1922-September 1934.	12	164	300	568	1.9	23
Lake Waco.....	Waco, Tex.....	April 1930-March 1935.	5	42,223	25.41	61.78	2.43	12.16
White Rock.....	Dallas, Tex.....	1910-35.....	25	19,540	171.41	140.83	.82	20.54
Guthrie.....	Guthrie, Okla..	October 1920-May 1935.	14.5	3,232	243.03	234.81	.97	14.01
Boomer Lake.....	Stillwater, Okla.	March 1925-June 1935.	10.25	2,794	306.11	182.01	.59	6.05
Elephant Butte (Rio Grande).	Hot Spring, N. Mex.	January 1915-April 1935.	20.25	2,638,860	100.29	76.97	.76	15.5
San Carlos (Gila River).	Coolidge Dam, Ariz.	October 1928-February 1935.	6.33	1,247,999	92.15	43.05	.46	2.93

The annual percentage rate of capacity loss is not a direct result of erosion rates in the tributary watershed but depends to a great extent on the size of the reservoir in relation to drainage area. The importance of the latter factor is shown by the strikingly greater percentage rates of depletion where original storage per square mile of drainage is relatively small. Lake Waco, for instance, with least storage per square mile of drainage shows that reservoirs with the greatest annual capacity per unit area of drainage generally have lower percentage rates of depletion.

A full report on this work, with general discussions of the problem and results of previous investigation by other agencies, has been prepared for publication.

In addition to detailed surveys of the foregoing reservoirs, reconnaissance data were obtained by field examinations and consultation with reservoir officials in some 90 other cases in the three southerly regions of the country.

Cooperative activities during the year included the following:

1. Participation in the survey of the municipal reservoir at High Point, N. C., by the United States Geological Survey through the office of the district engineer, Asheville, N. C.

2. Participation in the survey of Elephant Butte Reservoir by the Bureau of Reclamation through the office of the superintendent of the lower Rio Grande project, El Paso, Tex.

3. Participation in the survey of Boulder Reservoir by the Bureau of Reclamation and the Coast and Geodetic Survey.

4. Cooperation of State, municipal, and industrial officials concerned with reservoirs was generally offered freely and utilized in every possible way in connection with the various reservoir surveys and reconnaissance investigations carried out during the year.

### ADMINISTRATIVE

At the close of the fiscal year, a reorganization of the Service, designed to facilitate administration and to accommodate the research and nursery activities taken over in the transfer to the Department of Agriculture, was in progress but had not been completed. Coincident with this structural reorganization, plans were in preparation for the designation of 11 regions throughout the country in order to decentralize responsibility and facilitate operations in the field.

During the fiscal year, the personnel of the Service increased from 2,273 to 6,622, because of the continued expansion of activities to include new demonstration areas in various sections.

The field staff of the Service totaled 2,195 at the beginning of the year as compared with 6,302 on June 30, 1935, an increase of 4,107. The Washington staff increased from 78 to 320 employees.

In the field, supervisory and technical personnel increased from 553 to 1,456 during the year, while field labor increased from 1,642 to 4,846 employees.

In order to build up a reserve of trained personnel for supervisory positions requiring a high degree of technical knowledge in soil-conservation practices, the Service inaugurated, during the year, a work-training program for agricultural-college graduates and men having at least 2 years of academic work in the agricultural sciences.

These trainees gained practical experience during the day by actual work in the field, and in the evenings were required to attend classes in which members of the project technical staff instructed them in the methods and technic of erosion control. The trainees were paid at the prevailing Public Works Administration labor rate for the locality.

While no assurance of permanent employment was given to the men, vacancies in the technical staff were filled, whenever advisable, from this group. This procedure in filling vacancies in the technical staff will be followed in the future.

In May, 1,041 men were employed in a trainee capacity by the several projects, representing the peak of this type of employment.

Operations during the year were carried on with funds made available by the Public Works Administration. Total expenditures during the year were \$10,259,760.64. This was an average monthly expenditure of \$854,980.05. Administrative expenses in Washington totaled \$569,194.58, or an average monthly expenditure of \$47,432.88. Expenditures in the field aggregated \$9,690,566.06, or an average of \$807,547.17 per month.

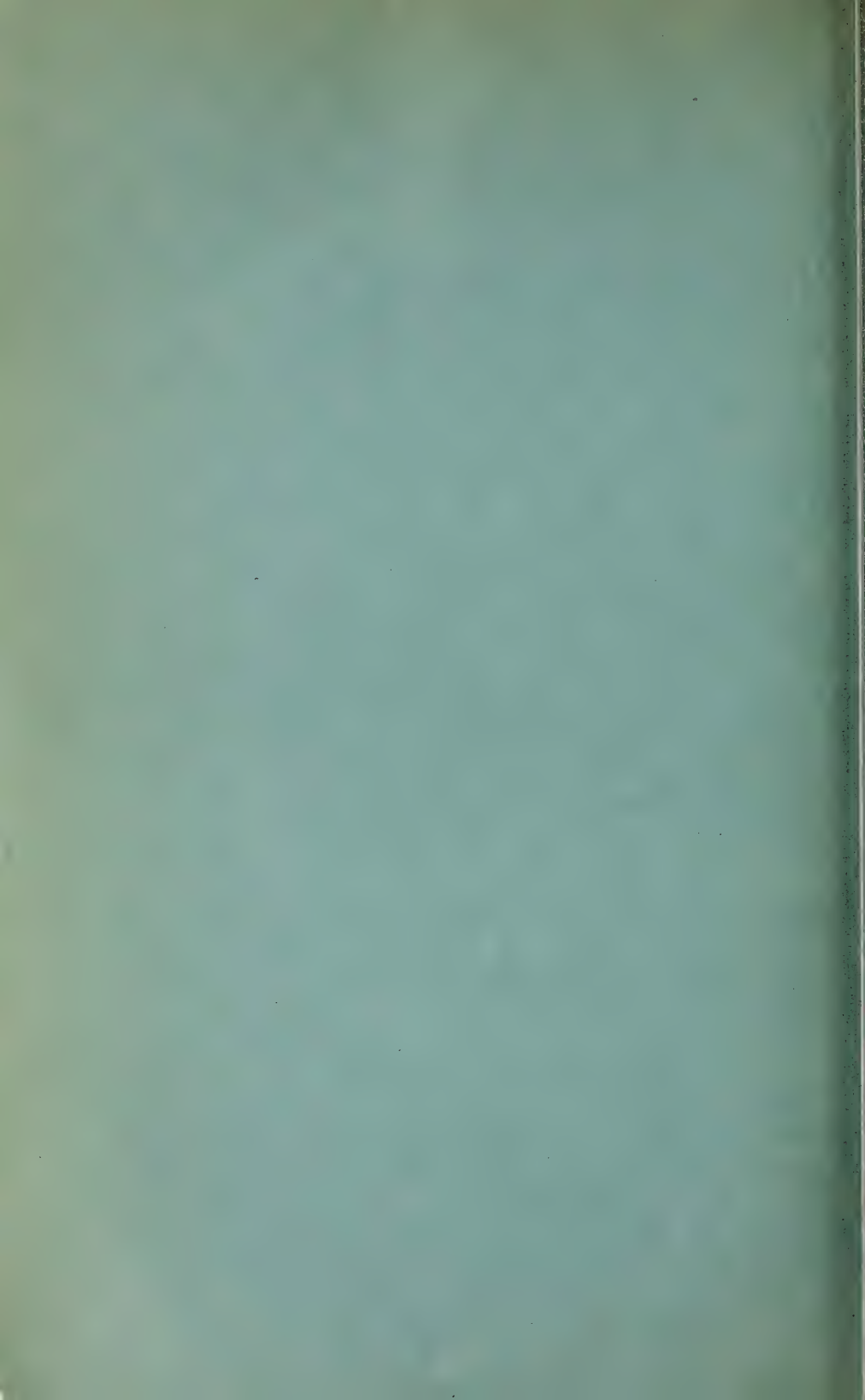
Salaries in the Washington office totaled \$316,353.79, while field salaries totaled \$5,247,802.27. Of the field salaries, \$1,836,730.79, or 35 percent, was for supervisory and technical personnel while \$3,411,071.48, or 65 percent, was for labor.













## REPORT OF THE SOLICITOR, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,

OFFICE OF THE SOLICITOR,

Washington, D. C., September 14, 1935.

HON. HENRY A. WALLACE,

*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith the report of the work of the Office of the Solicitor for the fiscal year ended June 30, 1935.

Sincerely yours,

SETH THOMAS, *Solicitor.*

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The work of the Office was very greatly increased during the year, due to the fact that on February 6, by direction of the Secretary, all the legal work of the Agricultural Adjustment Administration was taken over by the Solicitor.

There was also a very large increase in the legal work of the Office in connection with the Department's purchases of material, supplies, and equipment, which, owing to extra funds having been made available by emergency appropriations and various economy acts, for such purposes, have exceeded the amount spent last year by more than 100 percent.

Owing also to the increase in the funds made available for highway and road building by emergency acts and other acts supplemental to the Federal Highway Act there has been a corresponding increase in the work of the Office involved in the examination and approval of project agreements with the highway departments of the various States and all other cooperative agreements for road construction.

In the enforcement of the regulatory laws placed under the supervision of the Department, which have involved the prosecution of corporations or individuals for the violation of such laws through the medium of the Department of Justice, it is a pleasure again to make record of the fact that our relations with the officials and other representatives of that Department, as well as with the United States attorneys in Washington and throughout the various States, has continued to be marked with cordiality and effectiveness. In cases where the litigation, in which the Department is interested, has been carried on by United States attorneys, that work has been greatly facilitated by the preparation, in this Office, of complaints in the 28-hour law cases, libels in food and drug cases when practicable, and indictments and informations in practically all other criminal cases reported for prosecution.

The work of the Office has been conducted economically, expeditiously, and effectively during the fiscal year, and there follows a summary of that work in statistical form, including some details with respect to the various statutes involved.

### GENERAL SUMMARY OF WORK

In all, approximately 5,600 written opinions were rendered to administrative officials of the Department, no record being kept of the legal advice given to these officials in daily informal conferences or of the brief opinions informally written on papers sent to the Office for consideration or criticism.

Fifteen employees, arrested for alleged violations of traffic regulations while engaged in the performance of their official duties, were represented at their hearings and trials by attorneys of this Office. Twenty cases involving misconduct or indiscretion on the part of employees of the Department were passed upon legally and action taken by this Office.

Two thousand eight hundred and eighteen Notices of Judgment were prepared for publication pursuant to the authority given by the Food and Drugs, Insecticide, and Federal Caustic Poison Acts.

In addition to the criminal prosecutions hereinafter tabulated, 1,882 decrees of condemnation and forfeiture were entered under the Food and Drugs, Insecticide, Federal Caustic Poison, and Federal Seed Acts.

There were prepared for prosecution by the Attorney General 1,533 violations of regulatory statutes entrusted to the Department for enforcement.

Table 1 shows the several statutes for violations of which cases were reported, and also the amounts of fines, penalties, and other recoveries, in the cases which were settled either with or without contest.

TABLE 1.—Cases reported and fines imposed

Law involved	Cases	Fines
	<i>Number</i>	<i>Dollars</i>
Insecticide Act.....	79	3,806.00
Food and Drugs Act.....	418	41,958.56
Meat Inspection Act.....	35	210.00
Federal Seed Act.....	25	2,200.00
Federal Caustic Poison Act.....	17	80.00
Naval Stores Act.....	9	875.00
Standard Container Act.....	3	60.00
Produce Agency Act.....	7	1,700.00
Animal Quarantine Act.....	42	3,000.00
28-hour law.....	248	10,250.00
Plant Quarantine Act.....	7	480.00
Upper Mississippi River Wildlife and Fish Refuge Act.....	7	50.00
Migratory Bird Treaty Act.....	548	6,950.00
Bird and animal reservation law.....	3	110.00
National forest laws.....	85	7,917.04
Total.....	1,533	79,646.00

In addition to the foregoing, many alleged violations of regulatory statutes were reported by administrative officers and given consideration, but, because the evidence available was not sufficient to warrant prosecution, they were not submitted to the Department of Justice.

Table 2 summarizes the number of contracts and leases prepared or examined during the fiscal year, except those involving the Federal Highway Act and other acts supplemental thereto, which are reported in detail on pages 19 and 20.

TABLE 2.—Contracts and leases prepared or examined

Bureau, division, or office	Con- tracts	Leases	Total	Bureau, division, or office	Con- tracts	Leases	Total
Agricultural Adjustment Administration.....	9	79	88	Library.....	2	0	2
Agricultural Economics.....	8	26	34	Operations.....	0	3	3
Agricultural Engineering.....	3	2	5	Food and Drug Administration.....	3	1	4
Animal Industry.....	10	28	38	Forest Service.....	1,443	22	1,465
Biological Survey.....	50	8	58	Personnel and Business Administration.....	10	1	11
Chemistry and Soils.....	8	1	9	Weather Bureau.....	13	10	23
Dairy Industry.....	11	2	13	Extension Service.....	0	3	3
Entomology and Plant Quarantine.....	2	60	62	Total.....	1,605	292	1,897
Plant Industry.....	30	21	51				
Public Roads.....	3	25	28				

In addition to the items listed in table 2, there were submitted, for examination as to sufficiency of form and execution, numerous contracts prepared by various bureaus and by individuals and corporations. Until May 27, 1935, the date of the decision of the Supreme Court in the *Schechter case* (295 U. S.), all contracts and leases were made subject to applicable codes of fair competition, pursuant to Executive Order No. 6646, except as to certain specific exceptions authorized by the National Industrial Recovery Administration. Since

that date, pursuant to Circular Letter No. 100, issued by the Director of Procurement of the Treasury Department, an effort has been made to have all prospective contractors and lessors agree to a modification of their contracts or leases, as the case may be, to conform to any future legislation having to do with minimum wages, maximum hours of employment and/or limitation as to age of employees.

During the year, 27 bonds covering Department employees, and 438 renewals and 28 terminations of leases and contracts were prepared. In addition to the examination of the above-tabulated contracts and the bonds connected therewith for sufficiency as to execution, there were examined for sufficiency of form and execution 780 cooperative agreements with State experiment stations and others covering experimental work of various kinds. There were also examined, as to sufficiency of form and execution, 59 bid bonds submitted in connection with proposed contracts; 119 bonds of indemnity covering advances of funds under the Subsistence Expense Act of 1921; 3 bonds for advances of funds under the act of June 3, 1902, and 14 bonds covering the duties of milk administrators under the Agricultural Adjustment Administration. In connection with these bonds, numerous letters were written to the surety companies involved in reply to their letters of inquiry relative to the status of the bonds from the standpoint of accounting for advances and the retiring of such bonds where same were no longer required. As shown in detail later, there were also examined 8,527 highway-project statements and highway-project agreements and modifications thereof.

During the year, 437 certifications of records, bulletins, and other papers of the Department were prepared for use as evidence by outside litigants at their request, for use in court proceedings.

Two claims of deceased employees were examined. The claims were for balances of salary or retirement funds.

Approximately 500 claims covering damages to privately owned property, due to alleged negligence of Department employees, were examined pursuant to the act of December 28, 1922, and advice was given with respect thereto. In addition to the original examination, a great many claims were reopened and again given consideration, on request of a claimant, where additional facts were presented.

Thirty claims involving damage to private property under contract of hire to the Forest Service were considered under the act of March 4, 1913, as amended by the act of January 31, 1931.

Forty-three claims arising under the act of May 27, 1930, for damage in connection with the protection, administration, and improvement of the national forests were also presented and decided by this Office.

Five claims for money due the United States were prepared for filing under the provisions of the Bankruptcy Act, as amended.

In addition to the claims just mentioned, others arose from time to time. A number of miscellaneous cases arising out of automobile accidents were prepared and forwarded to the Department of Justice for collection. In several cases this Office was able to effect collection without resorting to suit. Claims, five in number, presented against the Department, under no specific act of Congress, were also considered. Numerous claims for money due the different bureaus, covering inspection fees, grazing fees, and similar charges were also handled.

Assistance was also given by representatives of this Office in the preparation of regulations, orders, and memoranda of the Secretary and in the preparation of legislation affecting the Department.

Attorneys of the Office, conducted, participated in, or attended as legal advisers at, numerous hearings under the Food and Drugs, the Packers and Stockyards, the Plant Quarantine, the Perishable Agricultural Commodities, and the Grain Futures Acts.

## FOOD AND DRUGS ACT

(34 Stat. 768)

At the beginning of the fiscal year, 750 cases were pending in the courts under the Federal Food and Drugs Act. Of these, 273 were criminal and 477 were civil cases. During the year 418 criminal cases, involving 1,260 violations, were reported to the Department of Justice, and 2,350 civil cases, a total of 2,768. There were thus pending during the year 691 criminal cases



and 2,827 civil cases, a total of 3,518. There were terminated during the year 426 criminal cases and 2,424 civil cases, a total of 2,850, leaving 265 criminal cases and 403 civil cases pending at the close of the fiscal year, or a total of 668.

The 426 criminal cases disposed of were terminated as follows: 287 upon pleas of guilty and the imposition of a fine; 66 upon a plea of *nolo contendere* and the imposition of a fine; 25 by dismissal or *nolle prosequi*; 2 barred by the statute of limitations; 1 by a plea of *nolo contendere* and the imposition of sentence deferred 1 year; 5 by verdicts of not guilty; 1 by a plea of *nolo contendere* and a finding of not guilty; 5 by a plea of *nolo contendere* and the defendant placed on probation; 1 upon a plea of guilty and the defendant ordered to pay the costs; 8 upon a plea of guilty and the imposition of the sentence suspended; 2 upon a plea of *nolo contendere* and the imposition of sentence suspended; 1 upon motion to quash being sustained; 8 because the information had not been filed; 1 upon a verdict of guilty and imposition of sentence suspended; 2 upon a plea of guilty as to part of information and plea of *nolo contendere* as to part of information and imposition of fine; 1 upon a verdict of guilty and imposition of a jail sentence; 1 upon a plea of guilty and the defendant placed on probation; 9 by a verdict of guilty and the imposition of a fine. Fines were imposed as shown in table 3.

TABLE 3.—*Fines imposed in criminal cases (exclusive of costs, which were generally assessed) under the Food and Drugs Act, fiscal year 1935*

Cases (number)	Amount of fine	Total	Cases (number)	Amount of fine	Total	Cases (number)	Amount of fine	Total
1.....	\$0.01	\$0.01	1.....	\$52.50	\$52.50	8.....	\$300.00	\$2,400.00
1.....	.05	.05	1.....	55.00	55.00	1.....	301.00	301.00
9.....	1.00	9.00	3.....	60.00	180.00	1.....	350.00	350.00
3.....	2.00	6.00	11.....	75.00	825.00	7.....	400.00	2,800.00
1.....	3.00	3.00	4.....	80.00	320.00	1.....	404.00	404.00
1.....	4.00	4.00	1.....	90.00	90.00	1.....	425.00	425.00
7.....	5.00	35.00	57.....	100.00	5,700.00	1.....	450.00	450.00
1.....	7.50	7.50	1.....	120.00	120.00	3.....	500.00	1,500.00
22.....	10.00	220.00	1.....	125.00	125.00	1.....	600.00	600.00
1.....	12.50	12.50	7.....	150.00	1,050.00	1.....	650.00	650.00
4.....	15.00	60.00	1.....	153.00	153.00	2.....	700.00	1,400.00
4.....	20.00	80.00	1.....	158.00	158.00	1.....	800.00	800.00
1.....	22.50	22.50	1.....	170.00	170.00	1.....	900.00	900.00
67.....	25.00	1,675.00	2.....	180.00	360.00	2.....	1,000.00	2,000.00
4.....	26.00	104.00	18.....	200.00	3,600.00	1.....	1,125.00	1,125.00
3.....	27.00	81.00	1.....	208.00	208.00	1.....	1,200.00	1,200.00
2.....	28.00	56.00	2.....	210.00	420.00	1.....	2,400.00	2,400.00
11.....	30.00	330.00	1.....	215.00	215.00	Total (368 cases).....		
1.....	30.50	30.50	2.....	225.00	450.00			
1.....	35.00	35.00	1.....	240.00	240.00			
3.....	40.00	120.00	5.....	250.00	1,250.00			
2.....	45.00	90.00	1.....	251.00	251.00			
60.....	50.00	3,000.00	1.....	270.00	270.00			41,958.56

Of the 2,424 civil cases terminated, 1,379 were terminated by default decrees of destruction; 454 by consent decrees of destruction; 469 by consent decrees, goods released under bond for reconditioning; 110 dismissed (chiefly because no seizure of the goods had been effected); 7 by trial and verdict for the Government; 3 by trial and verdict for the claimant; and 2 by exceptions to the libel being sustained.

Two thousand seven hundred and fifty notices of judgment were prepared and published during the year.

#### CASES OF INTEREST

The case of *United States v. Microsan Mosene Laboratories, Inc., and Mrs. Carrie S. Wright*, which was tried in the District Court of the United States for the Southern District of California, was a criminal proceeding instituted by information on one count alleging the shipment in interstate commerce of an article of drugs bearing false and fraudulent therapeutic claims. The case was tried before a court and jury. The Government produced medical evidence to show that an article consisting of an aqueous solution of drug extractives, a mercury salt, and glycerin was not in the consensus of medical opinion a

"specific" for tuberculosis, as alleged by the defendants upon the label of the product. Evidence was also introduced which disclosed that the defendant, Mrs. Carrie S. Wright, president of the Microsan Mosene Laboratories, Inc., for a number of years, had operated tuberculosis sanatoria in different sections of the country and by reason of the failure of the drug to cure patients affected with tuberculosis had actual knowledge that the preparation was worthless. The defendant, in an attempt to show good faith, introduced evidence that the formula of the remedy had been discovered by physicians and the preparation had proved beneficial in certain instances in the treatment of tuberculosis. At the conclusion of the evidence and the court's charge to the jury, a verdict of guilty was returned. The court suspended sentence for 2 years on condition that the defendants refrain from violating any of the laws of the United States and also refrain from selling, engaging, or dealing in any manner with the article of drugs involved in the case.

The cases of *United States v. 5 One-Pint Bottles and 23 One-Gallon Bottles, more or less, of Elixir Terpin Hydrate and Codeine*, and *United States v. 14 One-Gallon Bottles and 4 One-Pint Bottles, more or less, of Elixir Terpin Hydrate and Codeine* were tried together in the District Court of the United States for the Southern District of New York, and a jury waived. The product involved was alleged in the libels to be adulterated because sold under a name recognized in the National Formulary, but not conforming to the standards required by it, and misbranded because it was not stated on the container that one of the ingredients, codeine sulphate, is a derivative of opium or morphine. The Government produced evidence to show that the product was represented in its labeling to contain 30 percent of alcohol and each fluid ounce represented 1 grain of codeine sulphate, terpin hydrate 8 grains, and glycerin q. s., and that these ingredients and quantities were at variance with those prescribed by the formulary. The court held that, if a manufacturer wishes to use a National Formulary name for a nonconforming product, it is his duty to give the public unmistakable notice that in its composition there has been a departure from the formula given in the formulary. With respect to the misbranding referred to, the court held that, because the packages under seizure did not bear any notice that the codeine contained in the product is a derivative from opium or morphine, there was misbranding under the statute. There was also involved in the case and settled in favor of the claimant, the question of whether there was adulteration and misbranding of the product on the score that the contents of the bottles did not correspond with the declarations on the labels, which stated that each ounce contained 1 grain of codeine sulphate and 8 grains of terpin hydrate. The Government chemist testified that analyses disclosed more terpin hydrate than the quantity declared and less codeine sulphate. The claimant, however, produced testimony to show that the preparation, when compounded, had precisely the quantities of the ingredients specified on the label. In addition there was testimony that the test for terpin hydrate is unsatisfactory. The court held with respect to these charges that the burden of proof was on the Government and that its proof did not establish adulteration or misbranding by reason of discrepancy between the quantities set forth on the labels and the actual contents of the bottles. The court, because of the misbranding and adulteration previously referred to, found for the Government and entered a decree of condemnation and forfeiture.

The case of *United States v. Mallory H. Taylor, Jr., and Curtis J. Hazleriggs*, which was tried before Federal Judge Bascom S. Deaver and a jury for the District Court of the United States for the Middle District of Georgia, was one of special interest. The defendants in question were charged by indictment with conspiracy to violate the Food and Drugs Act. It was the contention of the Government at the trial that the defendants conceived the idea of placing on the market an article of drugs to be called "Warm Springs Crystal Compound" which was to be so labeled and advertised as to lead purchasers to believe that the product was evaporated from the waters of the springs at Warm Springs, Ga., when in fact it was to be merely Glauber's salt, a drug frequently used as a purgative for animals that can be purchased for 2 cents per pound, and which was to be repackaged in attractively labeled cartons of about 1 pound to sell for \$1; that such a product, if shipped in interstate commerce, would be a violation of the statute for the reason that the carton would be misbranded in such a manner as to deceive and mislead the purchaser. The Government produced testimony to show that subsequent to the alleged conspiracy the defendants made a number of shipments of the salt bearing labels of the type described. The de-



fendants at the trial produced testimony to show that there was no agreement or understanding upon the part of either of them to violate the Food and Drugs Act and that it was not their intention to deceive or mislead the public in any way in the sale of the product. At the conclusion of the trial the jury brought in a verdict of guilty as to both defendants, and the court imposed a sentence of 2 years in the Federal penitentiary upon each. However, upon motion for a new trial by the defendants, the court overruled the motion, but reduced the sentence of each defendant to a year and a day. The case is now pending on appeal by the defendants in the Circuit Court of Appeals for the Fifth Circuit.

The indictment in this case also charged one Walter C. Dunham as a participant in the conspiracy. Prior to the trial and conviction of the defendants Taylor and Hazleriggs, the defendant Dunham entered a plea of guilty and was sentenced by the court to serve a year and a day in the Federal prison at Atlanta, Ga.

The case of *United States v. Edmund C. Bellwood*, tried in the United States District Court of the Eastern District of Virginia, at Richmond, Va., before the court and a jury, was a criminal proceeding instituted by information against the defendant consisting of four counts. These counts each involved an interstate shipment on a different date and to different consignees by the defendant, of an article of drugs recommended in its labeling as a treatment for abortion and a corrective of nonbreeding of cattle. The representations made by the defendant upon the labeling of his product with respect to the efficacy of the preparation were alleged to be false and fraudulent. The Government showed by its chemists that the drug in question consisted of a powdered substance containing about 0.15 percent of potassium permanganate and the remainder of ordinary cornstarch. It was likewise shown by micro-analytical analysts that examination of the product under the microscope with ordinary light and also under a parallel polarizer or X-ray likewise disclosed the ingredients mentioned to be present in the percentages named; that the Government placed on the stand specialists from different sections of the country familiar with the treatment and manifestations of the diseases mentioned, who testified that infectious abortion or Bang's disease is self-limiting and reaches its highest state of virulency during one breeding season in a herd of cattle and by the next year the affected animals have acquired a tolerance so that thereafter there will not be so many abortions in the herd, and that the remedy in question, in the consensus of veterinary medical opinion, would have no effect whatever upon the cattle. Witnesses also testified that defendant, prior to the shipments alleged, had been informed by the Department of Agriculture that the product marketed by him was worthless and useless in the treatment of the diseases and conditions mentioned. The defendant, in an attempt to show good faith, produced a number of witnesses who testified that their cattle had been afflicted with Bang's disease and had been greatly benefited by the treatment. At the conclusion of all the evidence and the charge of the court to the jury, the jury returned a verdict of guilty on all counts of the information. Imposition of sentence was suspended by the court for a period of 3 years on condition that defendant make no interstate shipments of the drug involved. Defendant has indicated his intention of appealing.

### FEDERAL SEED ACT

(37 Stat. 506)

At the beginning of the fiscal year, there were 21 criminal and 10 seizure cases pending under the Federal Seed Act. During the year 25 criminal and 45 civil cases were reported to the Attorney General. Twenty-two of the criminal cases were terminated as follows: 8 on pleas of guilty and the imposition of a fine of \$200; 1 on a plea of guilty and the imposition of a fine of \$25; 1 on a plea of guilty and the imposition of a fine of \$350; 5 on a plea of *nolo contendere* and the imposition of a fine of \$200; 1 on a plea of *nolo contendere* and the imposition of a fine of \$25; 2 by *nolle prosequi*; 2 by a verdict of not guilty; 1 in which the information was not filed; and 1 on a plea of *nolo contendere* and the imposition of sentence suspended. Forty-six of the civil cases were terminated—22 by default decrees; 13 by consent decrees and the goods released under bond; 7 were discontinued, and 4 because no seizure could be effected. There were thus pending at the close of the fiscal year 24 criminal cases and 9 civil cases, a total of 33.



**FEDERAL CAUSTIC POISON ACT**

(44 Stat. 1406)

At the beginning of the fiscal year 1 seizure and 1 criminal case were pending under the Federal Caustic Poison Act. During the year 6 seizure cases and 17 criminal cases were reported to the Attorney General. Four of the criminal cases were terminated as follows: 1 on a plea of nolo contendere and the imposition of a fine of \$5, and 3 by a plea of guilty and the imposition of a fine of \$25. Six seizure cases were terminated as follows: 3 by default decrees of destruction; 1 by a consent decree; 1 dismissed; 1 not filed. There were thus pending at the close of the fiscal year 1 seizure case and 14 criminal cases.

Four notices of judgment were prepared and published during the year.

**NAVAL STORES ACT**

(42 Stat. 1430)

No cases were pending at the beginning of the fiscal year. Nine criminal cases were instituted during the year and 5 were closed, leaving 4 cases pending at the close of the fiscal year 1935. The cases closed were terminated as follows: 1 by a plea of nolo contendere and the imposition of a fine of \$75; 1 by a plea of nolo contendere and the defendant placed on probation; 1 by a plea of guilty and the imposition of a fine of \$750; 1 on a plea of guilty and the imposition of a fine of \$50; and 1 by a verdict of not guilty.

One notice of judgment was prepared and published during the year.

**MEAT INSPECTION LAW OF MARCH 4, 1907**

(34 Stat. 1260)

Seventeen cases were pending at the beginning of the year. Thirty-five cases were reported to the Attorney General for prosecution during the year.

Of the cases referred to, convictions were secured in 11, resulting in the assessment of fines as follows: 2 of \$50 each, 3 of \$25 each, 2 of \$10 each, and 2 of \$7.50 each. In 2 cases pleas of guilty were entered and the defendants were placed on probation for 6 months; 1 case was dropped or dismissed, and in one case the grand jury returned a no bill.

Nine cases which had been reported prior to July 1, 1934, and 30 cases reported during the fiscal year were left pending on July 1, 1935.

Fines aggregating \$210, imposed as stated above, are tabulated as shown in table 4.

**TABLE 4.—Fines imposed in meat-inspection cases**

Cases (number)	Fines in each	Total fines	Cases (number)	Fines in each	Total fines
2	\$50.00	\$100	2	\$7.50	\$15
3	25.00	75			
2	10.00	20	Total (9 cases)		210

**THE INSECTICIDE ACT**

(36 Stat. 331)

At the beginning of the fiscal year 1935, 39 cases were pending, 23 of which were criminal cases and 16 of which were civil or seizure cases. During the year ending June 30, 1935, 97 cases were reported to the Attorney General, in 79 of which criminal prosecutions were recommended, and in 18 of which civil or seizure actions against the products were recommended.

Of the 102 criminal cases either pending at the beginning of, or reported during the year, pleas of guilty were entered in 43, pleas of nolo contendere were entered in 12, and 8 were dropped or dismissed, leaving 39 criminal cases pending July 1, 1935.

Of the 34 civil or seizure cases either pending at the beginning of or reported during the fiscal year, 23 were terminated by the entry of default decrees of condemnation and destruction, 3 by consent decrees of condemnation, followed by the taking of the goods down under bond for reconditioning or relabeling, and one was dropped, leaving 7 civil or seizure cases pending July 1, 1935.

The fines imposed in the criminal cases referred to above consist of \$400 in 1 case; \$375 in 1 case; \$300 in 1 case; \$250 in 1 case; \$200 in each of 2 cases; \$150 in each of 4 cases; \$130 in 1 case; \$100 in each of 4 cases; \$75 in 1 case; \$50 in each of 5 cases; \$40 in each of 2 cases; \$35 in 1 case; \$25 in each of 18 cases; \$15 in 1 case; \$12.50 in 1 case, \$10 in each of 2 cases; \$5 in each of 2 cases; \$2.50 in 1 case; and \$1 in 1 case, the total of the fines assessed being \$3,806.

### MIGRATORY BIRD TREATY ACT

(40 Stat. 755)

Five hundred and forty-eight cases were referred to the Attorney General under the Migratory Bird Treaty Act, and fines amounting to \$6,985 were imposed for violations in 278 cases, as shown in table 5.

TABLE 5.—*Fines imposed under Migratory Bird Treaty Act*

Cases (number)	Amount of fine	Total	Cases (number)	Amount of fine	Total
20.....	\$1	\$20	1.....	\$75	\$75
37.....	5	185	7.....	100	700
81.....	10	810	1.....	150	150
19.....	15	285	2.....	200	400
14.....	20	280	1.....	250	250
70.....	25	1,750	2.....	500	1,000
3.....	30	90			
1.....	40	40	Total (278 cases).....		6,985
19.....	50	950			

In addition to the fines imposed, as above, the defendant, in 1 case, received a sentence of 4 months, and in another case 90 days. In all, jail sentences totaling 1,190 days were imposed. Fines amounting to \$1,040 were remitted by the courts. In 9 cases defendants were found not guilty; in 17 cases suspended sentence was given; the number of defendants placed on probation amounted to 14; 1 no true bill was returned by the grand jury; 6 cases were closed because of insufficient evidence.

### UPPER MISSISSIPPI RIVER WILDLIFE AND FISH REFUGE ACT

(43 Stat. 650)

Twelve cases involving violations of the Upper Mississippi River Wildlife and Fish Refuge Act were prepared and referred to the Attorney General for prosecution. Of the cases so reported and of those already pending, 7 were closed during the year. Of these, 2 cases were dismissed; in 1 the defendant was given 3 months in the workhouse; in 1 the defendant was given 2 days in jail; in 2 cases the defendants were given a year in the house of correction; and in 1 case the defendant was fined \$50.

At the close of the year there were 10 cases still pending.

Pursuant to this act and in addition to the criminal cases reported, other legal work was done by this Office, as follows:

The controversy with the State of Wisconsin and various private claimants was terminated and complete title vested in the United States. Arrangements were made with the War Department to pay for the full fee simple title in connection with the 9-foot channel project to the lands agreed to be swamp in character, and Wisconsin paid from the moneys received the amounts stipulated to be paid to the private claimants. Other large areas of land acquired by the United States through the War Department have been acquired in fee instead of a mere easement to flood. This Office has participated with the Land Acquisition Section of the Bureau of Biological Survey in bringing about these results, and local cooperation has been given to the attorneys for the War Department working on this project.

Abstracts have been obtained and title investigation completed on purchase cases involving 793.31 acres, which are pending final approval in the Department of Justice. One direct purchase case involving 81.48 acres was completed and title vested in the United States. Five condemnation proceedings involving 6,369.12 acres are pending awaiting final decree. Three condemnation proceedings involving 1,823.39 acres have been concluded and the title taken in the United States.

In the case of *Alexander Hanifl v. Ray Steele* (agent, Bureau of Biological Survey), involving a boundary question, assistance has been rendered to the Department of Justice, and the case has been transferred to the United States district court for trial.

In connection with land acquisitions for the Biological Survey wildlife-conservation program, assistance has been given to the Federal Emergency Relief Administration, Resettlement Administration, and the Department of Justice on the Mud Lake, Talcott Lake, and other projects in Minnesota.

### MIGRATORY BIRD CONSERVATION ACT

(45 Stat. 1222)

There was but one case prepared and forwarded to the Attorney General for prosecution under the Migratory Bird Conservation Act, and this case was still pending at the close of the year.

Pursuant to this act, and in addition to the criminal case reported, other legal work was done by the Office, as follows:

*Charleston County, S. C.*—Assistance was given the Department of Justice in the matter of the claim of the Cape Romain Land Co., arising out of the purchase of their lands by the United States, now pending before the Court of Claims.

*Garden County, Nebr.*—Many questions arising from the activities of the Lake Water Carrying Co. were given consideration by this Office.

*Burleigh County, N. Dak.*—Title to 320 acres, acquired for the Long Lake Wildlife Refuge, has been taken in the United States.

*Dorchester County, Md.*—The agricultural rights in 8,000 acres of land, known as the "Delmarva Fur Farms", a part of the Blackwater Wildlife Refuge, have been acquired and title vested in the United States.

*Donations.*—Consideration was given to several offers of land lying in South Carolina and to the legal questions involved.

*Administration of refuges.*—Many questions in connection with the administration of migratory-bird refuges under the above act, upon which legal opinions were necessary, were given extensive consideration.

*Executive orders and proclamations.*—Many Executive orders, relating to the setting aside of public lands for wildlife refuge purposes, and other Executive orders and proclamations relating to the allocation of money for the protection of wildlife and other uses by the Department of Agriculture, have been passed upon by this Office.

### MIGRATORY BIRD STAMP ACT

(48 Stat. 451)

Although a large number of violations of the Migratory Bird Stamp Act were brought to the attention of the Department, as the act was passed only in 1934 and amended in June 1935, the Bureau of Biological Survey felt that, for the first year, the emphasis should be upon an educational campaign with respect to the requirements of the act, with the result that only the aggravated cases were prepared and forwarded to the Attorney General for prosecution. There were 3 cases so reported, and in 1 of these the defendant was fined \$10; the other 2 cases were still pending at the close of the year.

### BIRD AND ANIMAL RESERVATION TRESPASS LAW

(Sec. 84 of the Penal Code)

During the year, three cases arising under section 84 of the Penal Code were forwarded to the Attorney General for prosecution. Of the cases so reported and those already pending at the beginning of the year, 15 were closed either by jail sentences or fines. The total amount of fines imposed was \$110. There were 23 cases pending at the close of the year.



## BEAR RIVER MIGRATORY BIRD REFUGE EXCHANGE ACT

(45 Stat. 448, 1186)

Due to the legal difficulties which prevented consummation of three land exchanges authorized by the Bear River Migratory Bird Refuge Exchange Act, it was decided to terminate all questions of title relative to the ownership of the lands involved by requesting the filing of two condemnation petitions.

A declaration of taking was prepared and filed as to 8,039.53 acres of the 15,519.27 acres involved in the exchange with Bear River Club Co., to enable improvements to be constructed free of all title questions.

## SAVANNAH RIVER WILDLIFE REFUGE

(Executive Order No. 5748)

The appeal of the United States from the adverse decision of District Judge Barrett (1 Fed. Sup. 321) resulted in a reversal and dismissal of the injunction suit of *Langdon Cheves v. Whitehead, as United States game protector*. The case was carried to the United States Supreme Court, but certiorari was denied (290 U. S. 704).

This left uncertain the ownership of the 423.63 acres of the Red Knoll Plantation, and a compromise was agreed upon under which the complete title became vested in the United States under a declaration of taking enabling a construction contract to be let. An enlargement of this refuge is being accomplished through purchases by the Resettlement Administration and by condemnation proceedings. Abstracts have been procured as to five tracts involving 2,021.07 acres, and condemnation proceedings requested and filed.

## LAKE MALHEUR RESERVATION

(46 Stat. 1552, 1562)

The prolonged controversy with the State of Oregon as to jurisdiction over 81,786 acres within the Neal survey lines, purporting to surround Malheur, Harney, and Mud Lakes, and the Narrows, was terminated by a decree of the United States Supreme Court on June 3, 1935. Assistance was given to the Solicitor General in the preparation of the briefs of the United States upon the questions involved. The rights of private claimants within the area were not affected. Except for small areas in the Narrows and Mud Lake divisions, the jurisdiction of the United States was upheld. The rights of the private claimants remain to be settled or adjudicated. Extensive preparations have been made for this undertaking. To avoid controversy with landowners adjacent to the Neal survey lines, there have been purchased or condemned to clear title 7,194.82 acres, of which 3,720.48 acres have been examined as to title and submitted to the Attorney General. Title to 2,651.77 acres in seven tracts have been finally approved as vested in the United States. By declaration of taking, 3,720.48 acres have become vested. There are five cases involving 1,068.71 acres pending.

The Eastern Oregon Live Stock Co. tract of 64,717.24 acres has been acquired through the Federal Emergency Relief Administration land program, with almost complete control of the waters of the Donner und Blitzen River. Stipulations have been entered into as to the pending water-adjudication case relating to this water.

As a result of allowing water to flow into the Malheur Lake division, claims for damages have been filed by 17 claimants for about \$19,169.17. These claims have been partly investigated. One has been withdrawn and another has been reduced.

## ACT FOR THE RELIEF OF UNEMPLOYMENT—LAND ACQUISITION

(48 Stat. 22)

Executive Order No. 6724, dated May 28, 1934, authorized the Secretary of Agriculture to expend \$1,000,000 in the purchase of lands for migratory-bird conservation purposes, and by Executive Order No. 6766, dated June 29, 1934, \$2,500,000 was authorized for expenditure in improvement of such lands.

The Federal Emergency Relief Administration land-acquisition program related only to purchase cases and to friendly condemnation proceedings, when such were necessary. To round out and complete the conservation projects it became necessary for this Office to condemn lands not under contract. Abstracts were ordered or obtained; petitions and declarations of taking were drafted, site acquisition accounts were prepared and submitted to the Comptroller General; and condemnation proceedings were instituted with reference to 17 projects involving tracts of land in North Dakota (5), Illinois, South Dakota (4), Oregon, Minnesota, Georgia, South Carolina, Michigan, Missouri, Nebraska, and Arkansas, ranging in acreage from 2.18 acres in one of the South Dakota projects to 85,260 acres in the Oregon project, and totaling 174,130 acres.

In many of the above cases the lands were immediately necessary for construction work. In such cases, declarations of taking were promptly filed and title to the land taken in the United States.

#### CASE OF INTEREST

Much time was expended by this Office in consummating the case of the Rockwell Powers Lumber Co. of Louisiana. Considerable correspondence was had with the vendors, the Department of Justice, and the General Accounting Office in order to reach a decision as to the nature and value of the claim arising out of the divestment of certain timber rights of the vendors, which resulted from the vesting in the United States of title to the lands subordinate to such timber rights and prior to their termination, and the exercise of control over the timber rights thus outstanding by the Department of Agriculture.

The Comptroller's office concluded from the evidence submitted that the United States did, in fact, take and acquire title to the outstanding timber rights of the Rockwell Powers Lumber Co., and that an agreement to pay for the said timber rights had been entered into. The approved account for \$24,241.94 was forwarded to the Department of the Treasury for payment.

#### NATIONAL INDUSTRIAL RECOVERY ACT—LAND ACQUISITIONS

(48 Stat. 195)

Funds allotted to the Federal Emergency Relief Administration for a land program included approximately \$6,000,000 for land acquisition in the furtherance of the Bureau of Biological Survey migratory-waterfowl conservation projects.

Project plans were submitted and approved by this Office for consideration by the Federal Emergency Relief Administration, and numerous conferences were had upon legal problems arising in connection with this land-acquisition work. It became necessary to set up a legal administration within the Federal Emergency Relief Administration to handle title work on these approved projects, and cooperation was given in establishing this Office.

The Solicitor's Office aided the Bureau of Biological Survey in the preparation of 25 projects involving approximately 523,600 acres, for submission to the Federal Emergency Relief Administration. Of these, 22 migratory-waterfowl projects were adopted for acquisition by the Biological Survey, being located in the following States: North Dakota (5), South Carolina (2), South Dakota (3), Montana (3), Oregon, North Carolina, Minnesota, Nebraska (2), Georgia, Michigan, Missouri, and Arkansas. The size of the tracts range from a 640-acre tract in Montana to 83,700 acres in Arkansas.

*Alaska.*—Three lots situated in Chitina, Alaska, were acquired by this Office through direct purchase for the Bureau of Biological Survey. This land was required for use in connection with game-management activities in Alaska.

*Prince Georges County, Md.*—As additions to the animal husbandry farm near Beltsville, 144.57 acres were acquired by condemnation and title vested in the United States. A condemnation with a declaration of taking is pending in the case of 124.19 acres. Many leases and options have been secured, involving 896 acres.

*Bureau of Plant Industry acquisitions.*—As an addition to the Stoneville experimental station 5.35 acres were donated by the Mississippi State College, and title is now vested in the United States. Several condemnation proceedings filed on behalf of the Bureau of Plant Industry have been consummated, and, as the outcome of three of these cases, the United States now has title to 202.5 acres in Washington County, Miss., 112.987 acres in Lincoln County, Mo., and 158.71 acres in Morton County, N. Dak.



Settlement of the J. C. Duke tract, in Iredell County, N. C., is still pending. Condemnation of 2 acres in Iredell County, N. C., as an addition to the Piedmont experiment station remains pending.

*Bureau of Agricultural Engineering acquisitions.*—Nine and eleven one-hundredths acres in Washington County, Miss., have been acquired as a donation from Mississippi State College for the use of the Bureau of Agricultural Engineering, and title is vested in the United States.

### MOUNT VERNON MEMORIAL HIGHWAY

There were pending at the time of the last annual report, eight cases relative to the acquisition of lands for the Mount Vernon Memorial Highway. These cases have now been closed, and all papers in connection with the title work have been turned over to the National Park Service of the Department of the Interior.

### NATIONAL ARBORETUM

There is only one small tract of land to be acquired out of \$386,000 appropriated by Executive order of the President for the purchase of arboretum property. The amount of land involved in this purchase will be less than 1 acre. This will close up the arboretum property insofar as the legal work of this Office is concerned.

### BID WORK OF THE DEPARTMENT

In connection with the bid work of the Department of Agriculture, due to the emergency appropriations and the provisions of the various economy acts, the purchasing activities of this Department have been materially increased and have incidentally required constant application to the Solicitor's Office for interpretations and decisions regarding various bids. The amount of bid work during the past fiscal year was considerably in excess of 4,084 cases, the sum involved aggregating more than \$22,000,000. Numerous complications arose due to the provisions of the National Industrial Recovery Act and the decision of the Supreme Court in the *Schechter case*.

### PATENTS

One hundred and thirty-five applications for letters patent, covering a wide variety of inventions made by employees, were given consideration during the year, and the papers in 48 new applications have been prepared. Thirty-nine patent applications have been passed to patent during the year. Eighty-one patent applications filed through this Department are now pending before the Patent Office.

The office has taken part in five interference proceedings declared by the Patent Office between applications for letters patent of employees of this Department and applications filed by outside parties. These proceedings involve the taking of testimony by the parties to the controversy, the filing of motions, the preparation of briefs, the submission of appeals to various tribunals, and the presentation of oral arguments. Three interferences have been concluded favorably to the Department, and two such cases are now pending before the Patent Office.

Numerous responses to actions of the Patent Office were prepared and filed and many informal conferences were held with the examiners in that office. Many questions presented by officials of the Department bearing on various phases of patent, trade mark, and copyright laws were considered and advice given.

### CASES OF INTEREST

The interference of *Charles W. Mann and Alexander G. Galloway v. James D. Huston* involves Patent No. 1696441, granted December 25, 1928, to Mann and Galloway, Department employees, and an application filed by Huston under date of August 6, 1926. Mann et al. filed their joint patent application July 5, 1928. They were the junior parties. The invention in issue has to do with precooling of lading stacked in refrigerator cars by means of reverse circulation of air. The examiner of interferences analyzed the testimony and failed to find any which established joint invention by Mann et al. prior to August 6, 1926, the



filing date of Huston. An award of priority to Huston was made on the technical ground that Mann et al. had failed to make their prima facie case. Mann et al. contended before the examiner of interferences that Huston had derived knowledge of the invention in issue from them, and appealed to the board of appeals from the decision of the examiner of interferences and assigned as one of their grounds for appeal the failure on the part of the examiner of interferences to substantiate the contention of derivation of Mann et al. The board of appeals and the Commissioner sustained this contention, and denied to Huston the right to a patent covering the patented claim which was the count in issue, and sustained the contention of the examiner of interferences that Mann and Galloway were improperly joined as patentees. The invention now resides in the public, where it has always been, by reason of Mann et al.'s dedication.

The patent interference case of *Robert T. Cotton and Harry D. Young, Department employees, v. Hans Schrader and Erwin Bossert* involves making a highly inflammable insecticide noninflammable. Cotton et al. moved to dissolve the interference on the ground that it was old in the art to make an inflammable insecticide noninflammable. The examiner of interferences sustained Cotton et al.'s contention, which, in turn, was upheld by the board of appeals.

The invention involved in the interference of *Alfonso Cortella and Pefer Lohn v. Raymond Evans*, a Department employee, was directed to a method of recording sound on motion-picture films. Evans moved to dissolve the interference, which was sustained by the examiner of interferences. No appeal was taken, and as a result Patent No. 1999754 was granted Evans on April 30, 1935.

The interference case of *T. Warren Allen and Clarence F. Rogers v. Kenneth H. Talbot, and Theodore C. Thee v. Harold V. Pullar and James W. Smith* involves Patent No. 1953890, granted Allen and Rogers, Department employees, and has to do with certain claims of this patent relative to the method of surfacing roadways. Pullar et al. is the senior party. This case is now pending.

The interference of *T. Warren Allen and Clarence F. Rogers v. Kenneth H. Talbot and Theodore C. Thee* involves the same patent as the case last referred to, with the exception that a different claim of the patent constitutes the count in issue. Allen et al. is the senior party in this case. This interference is now pending.

## PACKERS AND STOCKYARDS ACT

(42 Stat. 159)

On July 1, 1934, nine formal dockets were pending. During the year, 23 cases were instituted and final action was taken on 17. Fifteen were pending on June 30, 1935. The subject matter of the formal dockets dealt with trade practices on the part of many of the larger packers and others, stockyard rates, commission rates, solvency, bonds, and reparation. In 4 cases reasonable rates were prescribed, and in 1 involving stockyard rates the inquiry was dismissed. Only 1 case involved reparation, and an order denying the claim was entered. In the remaining cases, cease-and-desist orders, or suspensions, or both, were issued.

Attorneys of this Office appeared as counsel and officiated as examiners in a number of hearings held during the year, involving the reasonableness of rates and charges. Attorneys of this Office also appeared in other hearings based upon violations of the act. The records of some of these hearings were carefully reviewed, and narratives of some of them were made by this Office in cooperation with the Packers and Stockyards Division of the Bureau of Animal Industry. The reviewing and abstracting of the records in the other cases had not been completed at the close of the year. Oral arguments were made in several of the cases before the Secretary. Opinions have been furnished from time to time to the administrative officials concerning various legal problems in the enforcement of the act.

## CASES OF INTEREST

One of the most important cases was that of the *Secretary of Agriculture v. Armour & Co.*, and many of the other large packers, docket 440, involving alleged violations of title II of the act by a group of packers operating in certain Southern States. The case was begun in the previous fiscal year and the hearing

concluded in the present fiscal year. Approximately 1,000 witnesses appeared and testified during the course of the hearing, and the testimony comprised more than 24,000 pages, in addition to voluminous exhibits. Briefs were filed by counsel, and the case is set for argument on a date early in the next fiscal year.

In docket 425 the Secretary issued findings of fact, conclusions, and order, dated December 13, 1934, finding that the existing rates of the Sioux City Stockyards Co. were unreasonable and prescribing a schedule of reasonable rates and charges, which were put into effect by the respondent 30 days from the date of the Secretary's order.

In docket 435 the Secretary issued an order on September 27, 1934, finding that the existing rates of the commission companies at Denver, Colo., were unreasonable and prescribing reasonable rates. A petition for rehearing which had been filed by the commission men was denied on October 15, 1934, by the Acting Secretary. The case is now pending before a court of three Federal judges at Denver.

Docket 445 concerned the reasonableness of the commission rates at Fort Worth, Tex. A hearing, lasting about 3 weeks, was begun on October 11, 1934. A tentative draft of an order by the Secretary was prepared and submitted to the respondents. The case was argued on May 29, 1935, and was pending at the close of the fiscal year.

Docket 450 dealt with the reasonableness of the rates of the Denver Union Stockyards Co. at Denver, Colo. A hearing was begun on June 3, 1935, and concluded on July 3.

The Secretary's orders in the Kansas City commission rate case, the Chicago commission rate case, the Omaha Stockyards rate case, and the St. Joseph Stockyards rate case were severally passed upon during the year by a Federal district court of three judges, and in each instance the order was sustained. Representatives of this Office assisted the Department of Justice in the preparation of briefs and in the handling of these cases before the courts. In the Kansas City, Chicago, and St. Joseph cases preliminary steps have been taken to perfect appeals to the Supreme Court of the United States.

## THE GRAIN FUTURES ACT

(42 Stat. 998)

On November 13, 1934, the commission, under the Grain Futures Act, consisting of the Secretary of Agriculture, the Attorney General, and the Secretary of Commerce, issued an order in the case of the *Secretary of Agriculture v. Adrian Ettinger and Ewing W. Brand*, as individuals, and *Ettinger & Brand Co.*, partners (G. F. docket 6), in which the respondents were denied all trading privileges on all contract markets for a period of 6 months from December 1, 1934. The respondents' principal place of business was at Cleveland, Ohio, but they had a branch office at Chicago, Ill. It was alleged in the complaint that the respondents made grain-futures contracts in the months of May, June, and July 1933 with various parties and failed to keep a record of such transactions, disclosing the names and addresses of those persons for whom they kept their accounts. It was also alleged that the respondents submitted reports to a representative of the Department of Agriculture which contained false information as to the names and identity of the holders of grain-futures contracts on respondents' books. The facts generally alleged were admitted by the respondents, and their defense was largely in the nature of a plea in confession and avoidance. After weighing all the facts the commission thought that, while the respondents had violated the law, an order denying them the contract market privileges for an indefinite period or for a long time was not warranted, and that suspension for 6 months was sufficient.

The case against Arthur W. Cutten (G. F. docket 7) was instituted in the previous fiscal year, but not decided by the commission until February 12, 1935. An order was issued requiring that all contract markets refuse all trading privileges thereon to Arthur W. Cutten for a period of 2 years from March 1, 1935. This order is being contested in a proceeding pending in the Circuit Court of Appeals for the Seventh Circuit.

A complaint was filed by the Secretary on November 10, 1934, against Thomas M. Howell (G. F. docket 8), in which it was alleged by substance that Howell violated the provisions of the Grain Futures Act by cornering the corn market during July 1931. A hearing was held in Chicago beginning January 14, 1935,



and lasting for about a week. The case was argued before the commission by attorneys for the Government, and the respondent on June 17, 1935, and was pending at the close of the fiscal year.

### PERISHABLE AGRICULTURAL COMMODITIES ACT

(46 Stat. 531 and 48 Stat. 584)

A total of 308 formal decisions disposing of disciplinary complaints and claims for reparation were rendered by the Secretary during the year. Formal hearings were held in 88 cases. Licenses were revoked in 6 cases and suspended in 8 other cases. Reparations were awarded in the total amount of \$72,271.78. Eighty-two cases were dismissed. The marked diminution in the number of hearings held during this fiscal year, as compared with the last, is due to the fact that under the amendment of April 13, 1934, hearings need not be held where the amount claimed does not exceed \$500. The holding of hearings, the reviewing of the evidence, the preparation of decisions, findings of fact, and orders, and all other work of a legal nature were performed by attorneys in this Office.

### PRODUCE AGENCY ACT

(44 Stat. 1355)

At the beginning of the year, 16 cases, mostly based on charges of failing truly and correctly to account to shippers of vegetables, were pending in the United States courts. During the year 9 cases were dropped and 3 were terminated by convictions. In 2 of the latter a fine of \$100 each was imposed, in addition to securing the payment of the moneys to the shippers of the vegetables, and in the third case a fine of \$1,500 and a jail sentence were imposed. Seven informations were filed during the year, and at the end of the year 11 cases were pending.

In the case above mentioned in which a fine of \$1,500 was imposed (*U. S. v. Joseph Rosenblum*, in the United States District Court for the Southern District of Texas), the court in its charge to the jury said that the word "account" meant not only that the defendant was to give to the shipper the figures representing the amount which the car of vegetables sold for, including expenses involved, but that he is required by the statute to pay over to the shipper the shipper's part of the proceeds. The defendant contended that he never actually received the money in payment for the vegetables. As to this the court charged the jury that as a matter of law, if the defendant was credited with the money, i. e., if the defendant was indebted to the ones to whom he made the shipment and that if, instead of remitting to defendant, they credited him with the account, he thereby getting the benefit of it, that within the meaning of the act was the same as if the money had actually come into his hands.

### UNITED STATES STANDARD CONTAINER ACT

(45 Stat. 685)

Decisions were handed down by the courts in 4 cases instituted last year and in 1 instituted this year.

There were 2 cases against the Hope Basket Co., of Hope, Ark., for manufacturing illegally  $\frac{1}{2}$ - and 1-bushel continuous stave baskets. On pleas of nolo contendere the court assessed a fine of \$25 and costs (S. C. dockets 19 and 22). Similar cases were instituted against Walter Verhalen Co., of Dallas, Tex., for the unlawful sale of the baskets made by the Hope Basket Co., and upon a similar plea there was assessed a fine of \$25 and costs (S. C. dockets 20 and 21).

The case against H. A. DuBois & Sons, of Cobden, Ill., was for the unlawful manufacture of 1-bushel continuous stave baskets. The defendant was fined \$10 and costs (S. C. dockets 23).

There was one case pending at the close of the fiscal year against Elmer G. Porter, of Caywood, N. Y., for the unlawful sale of 10-quart hampers (S. C. docket 18).

Two prosecutions were recommended during the year, 1 against the Acme Can Co., of Philadelphia, Pa., and 1 other against L. Resnick & Sons, also of Philadelphia, for the manufacture and sale, respectively, of 2-quart metal hampers (S. C. dockets 26 and 25, respectively).



## TOBACCO STOCKS AND STANDARDS ACT

(45 Stat. 1079 and 47 Stat. 662)

One case under this act was reported to the Attorney General for prosecution for failure to furnish the report required by the act. Prosecution was not necessary, since the delinquent company complied with the act when it learned proceedings were about to be instituted.

## UNITED STATES WAREHOUSE ACT

(39 Stat. 486)

A number of opinions were given to the Bureau of Agricultural Economics on legal questions arising in the administration of the act. Rules and regulations for the enforcement of the act were considered as to their legal sufficiency.

## CASES OF INTEREST

In *United States v. Fred Hastings and J. B. Barner*, in the Federal District Court for the Northern District of Mississippi, involving a violation of the United States Warehouse Act by unlawfully removing cotton from a licensed warehouse, the defendant Barner pleaded guilty on January 30, 1935, and was sentenced to 8 months in jail. Hastings demurred to the indictment on the ground that the act was unconstitutional, that interstate commerce was not alleged in the indictment, and that an offense was not stated. The demurrer was sustained by the court on January 31. The Supreme Court has noted the case for consideration of the question of jurisdiction. A memorandum brief on the case was prepared for the consideration of the Department of Justice in connection with the question of an appeal to the Supreme Court.

## THE NATIONAL FORESTS

During the fiscal year there were handled 126 claims to lands within the national forests which were initiated under the public land laws of the United States. Decisions were rendered on 45 of these claims, 41 of which were favorable to the Government and 4 were unfavorable.

Attorneys of this Office participated in the trials of court cases and represented the Government before the United States local land offices in 27 hearings. There were handled also trespass cases involving property of the United States in national forests.

Oral advice was frequently given and numerous opinions relating to the administration of the national forests were submitted. There were prepared or passed upon for legal sufficiency 2,649 legal papers of various kinds.

Work for the Forest Service during the fiscal year, other than that under the Weeks forestry law, included handling the following cases and other business:

Claims to lands pending during year.....	126
Hearings attended.....	27
Briefs prepared and filed.....	16
General litigation and settlement.....	150
Contracts, leases, bonds, etc.....	1,423
Bills, complaints, informations, protests, etc.....	217
Abstracts of title examined.....	467
Court appearances.....	36
Written opinions.....	521
Stipulations.....	21
Trespasses:	
Grazing.....	35
Fire.....	30
Timber.....	28
Property.....	34
Occupancy.....	60
Miscellaneous.....	49
Cases under State laws.....	271

The amount of damages sustained and the fines imposed in 85 cases are shown in table 6.

TABLE 6.—*Trespass cases on the national forests in which damages and fines were recovered*

Character of trespass	Cases	Amount of damages	Fines imposed	Character of trespass	Cases	Amount of damages	Fines imposed
	<i>Number</i>	<i>Dollars</i>	<i>Dollars</i>		<i>Number</i>	<i>Dollars</i>	<i>Dollars</i>
Grazing.....	24	1,611.79		Occupancy.....	22	629.42	100.00
Timber.....	19	2,134.48	12.00	Miscellaneous.....	3	1,481.00	
Fire.....	8	1,286.74		Total.....	85	7,805.04	112.00
Property.....	9	661.61					

## WEEKS FORESTRY LAW

(36 Stat. 961)

The legal work incident to the acquisition of forest lands at the headquarters of navigable streams, under the Weeks Forestry Act of March 1, 1911, and the Clarke-McNary Act of June 7, 1924, was carried on in accordance with the acquisition program which had been approved.

During the year the National Forest Reservation Commission, created by the act of March 1, 1911, in the course of the five meetings which it held, authorized the acquisition of 7,650 land offerings in 25 of the States and in Puerto Rico, aggregating 3,923,976 acres. Inasmuch as a considerable volume of this acreage was authorized late in the fiscal year, the examination of titles and the acquisition of the land involved had not been completed when the year closed.

There were examined, reported, and approved for payment 2,219,701 acres of land at a purchase price of \$5,271,346, and there were 248 condemnation suits instituted, covering an aggregate of 783,757 acres, which included 1,530 offerings.

There are now pending in the Department of Justice the reports on 1,100,000 acres, which were submitted with a recommendation that their direct purchase be approved.

# **ACTS RELATING TO THE INTERSTATE MOVEMENT OF LIVESTOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVESTOCK, ETC.**

(23 Stat. 31; 26 Stat. 414; 32 Stat. 791; 33 Stat. 1264)

No cases were reported to the Attorney General for prosecution under the act of May 29, 1884 (23 Stat. 31). Of the cases pending at the close of the preceding fiscal year, 7 were dismissed, leaving 1 case pending under this act at the close of the year.

Forty-two cases were reported to the Attorney General for prosecution under the act of February 2, 1903 (32 Stat. 791), of which 20 were terminated by fines of \$100 each, and 4 by dismissal. Of the cases pending at the close of the preceding fiscal year, 10 were terminated by fines of \$100 each, 8 by dismissal, and 1 by the refusal of the grand jury to return an indictment. There were 23 cases pending at the close of the year.

No cases were reported to the Attorney General for prosecution under the act of March 3, 1905 (33 Stat. 1264). One case pending at the close of the preceding fiscal year was dismissed. No cases were pending at the close of the year.

In all, 42 cases were reported to the Attorney General during the year, and 24 were pending at the close thereof. In the enforcement of these laws, 30 cases were terminated by fines of \$100 each.

One case under title 18, section 88, United States Code, pending at the close of the preceding year, and involving an alleged conspiracy to violate the act of February 2, 1903, was dismissed for lack of evidence.

Regulations governing the elimination of cattle reacting to the blood test for Bang's disease (B. A. I. Order 347), and governing the importation of domestic livestock into the United States from all countries except Mexico (B. A. I. Order 352), and an order to prevent the introduction into the United States of rinderpest and foot-and-mouth disease (B. A. I. Order 353), were reviewed, as

were also other orders issued by the Department in connection with the administration of the above-cited laws.

Seven bonds to insure the handling, in according with the regulations of this Department, of hides, skins, etc., imported from foreign countries were examined during the year.

#### CASES OF INTEREST

In November 1934, pursuant to the authority of two acts of Congress of May 9, 1934 (48 Stat. 1350 and 1352), suits were instituted in the United States District Court of the Northern District of Texas, Fort Worth Division, against the United States, by 2 groups of claimants, 1 of which was composed of the partnership of Russell & Tucker, 4 other partnerships, and 4 individuals, the other group being composed of the partnership of Porter Bros. & Biffle, 2 other partnerships, 5 individuals, and the estate of 1 deceased individual. In these suits the claims for damages totaled approximately \$453,700 alleged to have resulted from the negligence of inspectors of the Bureau of Animal Industry of this Department in connection with the dipping and certification of cattle for shipment from certain points in Texas to certain points in Oklahoma in 1918 and 1919 under the rules and regulations of the Department governing the interstate movement of livestock.

On January 14 the court appointed a commissioner to take testimony in the cases, and on January 21 the taking of testimony was begun, continuing thereafter every day up to and including January 29, at which time the attorneys for the Russell & Tucker group of claimants asked that the hearing might be adjourned to some later date for the introduction of the testimony of certain of their witnesses who were ill and unable to be present for that purpose. As a result, the taking of testimony was not resumed until about 4 months later, on May 2, and was concluded on May 4. At this time it was the understanding that when the transcript of testimony had been completed by the reporter it would be formally presented to Judge Wilson, who would, at his convenience, thereafter set a day for argument and for the filing of briefs. At the close of the fiscal year no further action had been taken by the court.

These cases were handled in behalf of the Government by J. J. Greenleaf, special attorney for the Department of Justice, assisted by one of the attorneys from this Office.

#### TWENTY-EIGHT-HOUR LAW

(34 Stat. 607)

Two hundred and forty-eight cases were reported to the Attorney General under the 28-hour law. Penalties aggregating \$10,250 were recovered in 95 cases. Twenty-four cases were dismissed, and in one judgment was rendered for the defendant. Two hundred and twenty-nine cases were pending at the close of the year.

#### PLANT QUARANTINE ACT

(37 Stat. 315)

Prosecutions were instituted under the Plant Quarantine Act in seven cases during the year, either through the Attorney General or the United States attorneys or commissioners, on information furnished by the Department. All of these, as well as two cases pending at the close of the fiscal year 1934, were closed by the imposition of fines. No cases were pending at the close of the year. Table 7 shows the fines imposed in nine cases.

TABLE 7.—*Fines imposed in plant quarantine cases*

Cases (number)	Amount of fine	Total	Cases (number)	Amount of fine	Total
1.....	\$5	\$5	2.....	\$100	\$200
1.....	20	20	1.....	125	125
1.....	30	30			
2.....	25	50	Total (9 cases).....		450
1.....	50	50			



Four written opinions were given on legal questions raised by the Bureau of Entomology and Plant Quarantine, and many informal opinions were given in conferences with representatives of that Bureau. Conferences were also held and assistance given in connection with the issuance of new quarantines or in connection with the revision or amendment of existing quarantines or the regulations supplemental thereto, as follows: The revision of the Citrus Canker Quarantine No. 19; the Sugarcane Quarantine (foreign) No. 15; the Dutch Elm Disease Quarantine (foreign) No. 70; the Sugarcane Quarantine (domestic) No. 16; the Sweetpotato Quarantine (domestic) No. 30; and the rules and regulations supplemental to the Japanese Beetle Quarantine No. 48; amendment no. 1 to the regulations under the Pink Bollworm Quarantine No. 52; amendment no. 1 to the regulations supplemental to the Rice Quarantine No. 55; amendment no. 2 to the regulations supplemental to the Pink Bollworm Quarantine No. 52; amendment no. 1 to regulations supplemental to the Black Stem Rust Quarantine No. 38; amendment no. 1 to regulations supplemental to the Mexican Fruit Worm Quarantine No. 64; amendment no. 2 to the regulations supplemental to the Nursery Stock Quarantine No. 37; amendment no. 1 to regulations supplemental to the White Pine Blister Rust Quarantine No. 63; the removal of the restrictions on the interstate movement of fruits and vegetables under the Japanese Beetle Quarantine No. 48; the lifting of Narcissus Bulb Quarantine No. 62; public hearing on the advisability of quarantining the States of Connecticut, New Jersey, and New York on account of the Dutch elm disease; and the issuance of Quarantine (domestic) No. 71, on account of the Dutch elm disease, as a result of the hearing held on that subject.

### FEDERAL HIGHWAY ACT AND SUPPLEMENTAL ACTS

(42 Stat. 212; 46 Stat. 805; 47 Stat. 709; 48 Stat. 195 and 993; 49 Stat. 115)

During the fiscal year 1,318 original and 208 revised project statements for Federal-aid road projects approved by the Department were first reviewed to determine whether they were eligible under the law. The amount of Federal funds which these projects will involve is not yet fully determined, as the Federal funds are allocated only as the project agreements are entered into for the construction of the individual projects or sections thereof.

During the year 5,454 original project agreements and certificates of approval of plans, specifications, and estimates prepared by the Bureau of Public Roads were reviewed as to their form and sufficiency of execution by the State highway departments and were approved for execution by the Secretary or his authorized representative. Drafts of 1,145 modifications of project agreements and certificates of approval of plans, specifications, and estimates prepared by the Bureau of Public Roads for execution by the State highway departments and the Secretary or his authorized representative were similarly reviewed. Project agreements and modifications of agreements were executed during the fiscal year for work estimated to cost \$253,314,200.34, of which \$236,866,881.10 were Federal funds provided pursuant to section 204 of the National Industrial Recovery Act and \$7,388,160.28 from regular Federal-aid road appropriations. The projects covered by these agreements involve the improvement of 13,803 miles of road.

In addition to the foregoing, 77 original and 233 modified project agreements and certificates of approval of plans, specifications, and estimates, for work-relief projects prepared by the Bureau of Public Roads for execution by the highway departments and the Secretary or his representative, were reviewed as to form and sufficiency of execution by the highway departments. These projects involved construction work on 1,882.8 miles of road at an estimated total cost of \$10,853,203.27, of which 70 percent was provided by the Federal Emergency Relief Administration for direct payment for labor performed, and 30 percent was provided in the form of a grant by the Public Works Administration for payment through the Bureau of Public Roads for materials and items other than labor.

Altogether there were 6,909 separate sets of project agreement papers handled during the fiscal year, involving projects estimated to cost \$264,167,403.61 and providing for construction work on 15,685.9 miles of road.

Original project statements were also reviewed during the fiscal year for 8 flood-relief projects and original agreements for 12 such projects were reviewed prior to execution by the Department, involving a total estimated cost of \$485,093.84 and 48.2 miles of road.

There also were 107 cooperative agreements between the Department, and cooperating agencies for constructing roads within or partly within national forests, and 99 original construction contracts were entered into after advertisement and award for the construction of such roads. All such cooperative agreements and construction contracts, including the consideration of bids and awards based thereon, were considered as to form, substance, and sufficiency, prior to action thereon by the Department.

During the year there also were considered and approved by the Department 17 original project statements for Federal lands highway projects under the act of June 24, 1930 (46 Stat. 805). There also were 45 original and 10 modified project agreements for Federal lands highway projects involving an estimated cost of \$3,359,723.81 for the improvement of 391.2 miles of roadway. These project statements and agreements were likewise reviewed as to their form and sufficiency before action was taken thereon by the Department.

## AGRICULTURAL ADJUSTMENT ACT

(48 Stat. 31)

The legal work performed for the Agricultural Adjustment Administration involved several distinct activities, as follows:

### LITIGATION AND ADMINISTRATIVE ENFORCEMENT

#### COURT CASES

On June 30, 1935, there were pending in Federal courts throughout the country approximately 125 cases involving the validity of the Agricultural Adjustment Act or some action taken under the act, of which 9 were pending in the appellate courts. During the period many cases actually went to trial, and 7 were argued before a circuit court of appeals. In several instances specific licenses were held void on the ground that no interstate commerce was involved.

An action brought during 1934, which resulted in a decree upholding the constitutionality of the Sugar Act of May 9, 1934, was pending on appeal at the end of the year, but the appeal is to be dismissed by the appellants in the near future, as the Secretary and the producers of sugar in Hawaii have entered into a benefit contract, one of the conditions of which is the dismissal of the litigation. There have been no other court attacks upon the validity of this sugar act.

During the latter part of the year, considerable effort was expended in connection with processing-tax cases. By June 30, 1935, over 80 suits had been instituted in Federal courts throughout the country, most of them bills in equity praying an injunction to restrain the Collector of Internal Revenue from taking proceedings to collect the tax. The first case, involving the validity of the processing-tax aspects of the statute, was still pending and undecided in the Circuit Court of Appeals for the First Circuit in Boston. It is expected that immediately upon this court's decision an appeal will be taken to the United States Supreme Court. Thus the processing-tax provisions may be before the Supreme Court during the winter of 1935-36.

A number of criminal prosecutions have been instituted for frauds committed in connection with acreage-reduction and emergency-purchase programs undertaken pursuant to section 8 of the Agricultural Adjustment Act. These prosecutions have to do with the falsification of records with intent to defraud the Government, conspiracy to defraud the Government, and the willful making of false entries or statements in any report required under the act.

In connection with acreage-reduction programs, the indictments were returned against persons who had made false representations in their applications for benefit contracts, had made false certificates in claims for benefit payments, had forged checks, or had in other respects violated the criminal laws for the purpose of obtaining benefits under the programs. In connection with the emergency-purchase program indictments were returned against persons who made false representations relating to their ownership of cattle or hogs being purchased by the Government.

During the year 1 person indicted under the corn-hog program pleaded guilty and received a sentence of 18 months in the penitentiary. In other instances, a person charged with making false statements in his application for a wheat-allotment contract was fined and placed on probation for 1 year and another pleaded guilty to a charge of fraud and received a suspended sentence



of 12 months. At the end of the period 27 cases were pending, awaiting either indictment or trial.

The Bankhead Cotton Act of April 21, 1934, was before the courts in two cases. In one instance, in an action brought by a Texas producer of cotton against the Texas & New Orleans Railroad Co., the statute was upheld, and that case will be before the United States Supreme Court during the early winter. Recommendation has been made to the Solicitor General that the Government ask leave of the Supreme Court to file a brief as *amici curiae*, the case being between two private litigants, and the Government not a party thereto. In the other instance, a case involving the Bankhead Act was instituted in the Federal Court for the Eastern District of Texas by an individual ginmer and by the Texas Cotton Ginning Association on behalf of its members to obtain an injunction restraining the collectors of internal revenue from requiring any ginmer in the State from complying with the act and with the regulations promulgated by the Secretary of the Treasury. In that action, the plaintiffs took the position that the burden of the statute and of the regulations was ruinous and oppressive and resulted in depriving the ginners of their property without due process of law. The case was tried in Sherman, Tex., June 24-25, 1935, and at the end of the year remained undecided by the court. At the close of the year there were six cases pending in the courts involving the validity of this statute.

During the year, the Kerry-Smith Tobacco Act was challenged as to its validity in the case of *Penn v. Glenn*, and the statute was declared unconstitutional by Judge Dawson, sitting in the Federal District Court for the District of Kentucky, who ruled that the act is unconstitutional as an invalid effort on the part of the Federal Government to regulate and control the production of tobacco in the several tobacco-producing States. This decision is being appealed in the circuit court of appeals. In another case, a trial was had, but no decision has yet been rendered. In addition to these 2 cases, there are 4 cases pending in the courts in which the validity of the statute is in issue.

#### ADMINISTRATIVE ENFORCEMENT CASES

Section 8 (3) of the Agricultural Adjustment Act empowers the Secretary, after due notice and opportunity for hearing, to suspend or revoke the license of any person licensed under the act for violation of the terms or conditions thereof. With this purpose in view, two types of hearings under general regulations issued by the Secretary with the approval of the President, and known as General Regulations, Series 3, and General Regulations, Series 10, have been instituted in rather large volume. Under the first type, orders are served upon alleged violators requiring them to show cause within a reasonable, specified time why their licenses should not be suspended or revoked. A hearing is held under General Regulations, Series 3, if the answer is found to be insufficient, or if no answer is filed. The second type of hearing is merely an investigation. Under this proceeding the alleged violator is served with an order to show cause why the matter should not be referred to the Department of Justice with a request by the Secretary to the Attorney General to take appropriate action.

During the fiscal year, 138 formal complaints, alleging violations under 28 different licenses, were filed with this Office. Formal proceedings were instituted in 109 cases, of which 89 were under General Regulations, Series 3, and 20 were under General Regulations, Series 10. Hearings were held in 97 of the cases, of which 81 were held under General Regulations, Series 3, and 16 were held under General Regulations, Series 10. Formal orders of the Secretary revoking the licenses were issued in 26 cases, and 1 was referred to the Department of Justice for appropriate action.

Many reported breaches of licenses have been shown by the facts developed at the hearings to be due merely to misunderstanding by the licensee of the program and of the operation of the license in question. In some cases where satisfactory assurances of future compliance have been given by the offending licensee, the Secretary has not exercised his power of suspension or revocation, nor has he referred the matter to the Department of Justice.

In 29 of the 138 cases formally referred to this Office, no final action was taken, because the violators concerned, as the result of the proceedings, indicated a desire to comply with the license and assured the Secretary that they would do so. In 39 instances the cases were abandoned because the applicable licenses under which they were instituted were canceled, and 38 cases



are now being held in abeyance pending the outcome of adverse court rulings. In a number of these cases also future compliance has been promised by the respondents. In addition to these cases, 3 other proceedings docketed during the previous fiscal year were abandoned because the applicable license was canceled, and 8 such cases are being held in abeyance pending the final outcome of adverse court rulings.

#### NATIONAL INDUSTRIAL RECOVERY ACT CASES

Further work by the Office of the Solicitor was conducted in cases brought under the National Industrial Recovery Act of June 16, 1933, under which certain codes were jointly administered by the National Recovery Administration (later the National Industrial Recovery Board) and the Agricultural Adjustment Administration.

In the case of *United States v. Jos. Schecter et al.*, the Circuit Court of Appeals for the Second Circuit, sitting in New York City, sustained the conviction of the defendants on 17 of the 19 counts on which the defendants had been convicted, and reversed the conviction on the 2 counts involving the wage and labor provisions of the code. This case was reviewed by the United States Supreme Court on certiorari and on May 27, 1935, the Supreme Court reversed the convictions and held the Recovery Act invalid as an unconstitutional delegation of power by the President. The result of this case was that all work of administering the joint codes was immediately stopped. Pending action involving code violations was being withdrawn.

The only other actions under the Recovery Act involving jointly administered codes which reached trial during the period were *United States v. Ross R. Salmon et al.* (District Court, Western District of Missouri), and *United States v. Aurora Serum Co.* (District Court, Northern District of Illinois). The former involved violations of the code for the commercial and breeder hatchery industry and after indictment the defendants pleaded guilty and paid fines. The latter case was one for an injunction restraining the defendant from violating the code for the anti-hog-cholera serum industry, and after the case was submitted on an agreed statement of facts the court granted a permanent injunction.

#### CODES, MARKETING AGREEMENTS, AND LICENSES

During the year 172 licenses and 53 marketing agreements were drafted, (This includes new licenses, amended licenses, amendments to licenses, and terminations of licenses; also same with respect to marketing agreements.) In addition, in the course of administering the marketing agreements and licenses, 334 formal documents, among them designations of agents, approval of bonds, terminations, and other miscellaneous documents were drafted. Eight hundred and thirty-two opinions, memoranda, and letters were prepared on marketing agreements and licenses. There were 131 hearings attended in connection with these licenses and marketing agreements.

During the year all legal business relating to the administration of the Jones-Costigan sugar amendment of May 9, 1934, was consolidated in this section. Six basic sugar-benefit contracts and 1 grower-processor contract were drafted; in addition there were 44 formal documents, 247 letters, telegrams, memoranda, and opinions rendered. Attorneys attended 13 conferences and informal hearings.

In connection with section 12 (b) of the Agricultural Adjustment Act, which empowered the Secretary to use processing-tax funds for the removal of surplus agricultural commodities, the important programs were: (1) removal of Pacific Northwest wheat, and (2) emergency hog program; pursuant to which 78 opinions and other documents were drafted. Attorneys attended hearings of importance in Chicago, Ill., and Portland, Oreg., in connection with both these programs.

In connection with the Emergency Appropriation Act of June 19, 1934, under which a certain part of a \$525,000,000 appropriation was put at the disposal of the Secretary for relief in drought-stricken agricultural areas, there were the following important programs: (1) Purchase and disposal of seed; (2) purchase and distribution of feed and fodder (corn fodder and corn stover); and (3) purchase of sheep and goats; pursuant to which there were drafted and issued 2 agreements, 3 administrative rulings, 1 draft seed note, and 37 opinions or memoranda. An attorney was constantly attached to the seed conservation committee and sat with them during their meetings.

Under the Jones-Connally Cattle Act of April 7, 1934, authorizing the Secretary to use funds for purchase of surplus cattle and dairy products, the important programs were (1) emergency cattle program, (2) dairy products purchase program, and (3) Bang's disease program, pursuant to which there were drafted and issued 2 contracts, 8 administrative rulings, and 193 opinions and memoranda.

Under an Executive order issued pursuant to the National Recovery Act of June 16, 1933, the Secretary of Agriculture was vested jointly with the National Recovery Administration with power to draft codes relating to food products. Seven codes were executed, 6 going to the National Industrial Recovery Board, and 7 opinions rendered.

In addition, the administrative order series, of which there were 7, general regulations, of which there were 10, with 3 revisions and 4 amendments, and a total of 20 administrative rulings, were drafted. These relate not only to marketing agreements and licenses, but to various types of hearings which the Secretary might hold under the Agricultural Adjustment Act and the National Industrial Recovery Act and under the investigatory powers given him thereunder. There were also 91 opinions, memoranda, and letters issued in connection with these matters.

#### BENEFIT CONTRACTS

There were prepared, or assistance was given in the preparation of, 784 formal documents for use in connection with the production adjustment and surplus removal programs initiated by the Agricultural Adjustment Administration pursuant to the Agricultural Adjustment Act and related legislation. Such documents included 3 Executive proclamations, 6 Secretary's proclamations, 5 complete sets of regulations, 40 contract forms, 616 general forms, 6 purchase forms, and 108 administrative rulings. This total does not include the contracts and supplemental forms, rulings, and regulations in connection with the Louisiana, Florida, sugar beet, Puerto Rico, Philippine, and Hawaiian sugar programs, with respect to which preliminary work was done before the establishment in September 1934, of a separate unit to handle all phases of the sugar programs, and in so doing, numerous extended conferences were held with administrative officials and other departments with reference to the preparation of the programs and prepared preliminary drafts of contracts and other forms.

Four hundred and six formal opinions were submitted to administrative officials of the Agricultural Adjustment Administration. In addition thereto, there were 197 formal opinions prepared and submitted which were chiefly responsive to questions arising in the Benefit Contract Section in connection with the development of production adjustment programs.

During the year attorneys acted on various committees composed of the representatives of this Office and representatives of the Office of the Comptroller and the Commodity Section, which dealt with large numbers of individual or typical cases affecting various phases of the programs. Principal among such committees were the legal advisory committee, the committee on termination of rental and benefit contracts, and the committee on violations of rental and benefit contracts. Attorneys on these committees reviewed each case with respect to legal problems involved.

In connection with the work of the legal advisory committee, approximately 3,500 numbered opinions were prepared. Approximately the same number of opinions was given, of which no numerical record was kept, that had been kept only a portion of the time the committee was operative. Each such opinion was reviewed by a representative of the Office.

The attorney on the committee on termination of rental and benefit contracts reviewed the record and gave approval to the disposition of 11,485 cases of rejection of offers to benefit contracts or termination of contracts for noncompliance or other reasons.

An attorney of the Office served on the committee on violations of rental and benefit contracts, which disposed of 787 cases of violations, the record in each case having been reviewed as to legal problems and disposition.

Approximately 800 warehouseman's bonds for tagging old cotton under the Cotton Act of April 21, 1934, tendered in triplicate, were examined for legal sufficiency, and approximately 200 bonds of assistants in cotton adjustment, tendered in triplicate, were examined for legal sufficiency.

No record was kept of the legal advice given to administrative officials in informal conferences or in the form of brief informal opinions or on letters



and other documents informally submitted for suggestions or criticism. Nor was a tabulated record kept of the large number of letters and telegrams written or prepared for signature by administrative officials or reviewed as to legal form and content in response to inquiries by producers, State directors, county agents, committeemen, local representatives, and others with reference to the application and effect of the terms of production-adjustment contracts. A large volume of correspondence was prepared prior to January 1935 in connection with garnishments, attachments, and bankruptcy proceedings involving claims to payments under benefit contracts. It is estimated that the number of informal opinions, letters, telegrams, and documents referred to in this paragraph exceeded the number of formal opinions prepared.

Conferences were held between attorneys of this Office, administrative officials of the Agricultural Adjustment Administration, and representatives of the Farm Credit Administration in coordinating policies of those Administrations, particularly with respect to the legal and administrative feasibility of taking cognizance of claims of the Farm Credit Administration against contracting producers in entering into contracts with such producers with the Agricultural Adjustment Administration, or in making payments thereunder. Such problems have arisen in varying forms under the different programs and necessitated considerable correspondence and frequent and extended conferences.

Frequently conferences were had with representatives of the Comptroller General's staff in connection with contracts, supplemental forms, and the proposed procedure, designed for use of the Administration in carrying out its various commodity programs under consideration by that office. This Office has prepared the major portion of the letters of submission of such forms and memoranda supplementary thereto.

From 1 to 3 attorneys have been engaged with administrative officials in the preparation and consideration of proposed amendments to the Agricultural Adjustment Act, the Kerr-Smith Act, and the Bankhead Cotton Act, and other legislation considered in connection with suggested phases of production adjustment.

#### TAX WORK

The activities of the Office relative to taxation were concerned primarily with tax matters arising out of the administration of the Agricultural Adjustment Act, but occasionally questions arising under the Bankhead Cotton Act of April 21, 1934, and the Kerr Tobacco Control Act of June 28, 1934, were considered. Inasmuch as the taxes imposed by these statutes are collected by the Bureau of Internal Revenue, the attorneys in charge of the work were in constant daily contact with, and continuously rendered assistance to, representatives of that Bureau in the collection of these taxes.

Throughout the year, and particularly during the latter part, numerous suits were instituted by processors for refunds of taxes paid or for injunctions against the collection of taxes due, on the ground of the unconstitutionality of the laws under which they were imposed. In connection with these matters the attorneys in charge of this work have been in close communication with officials of the Department of Justice and with the United States attorneys in several States.

Written opinions to the number of 108 were rendered to administrative officials of the Department during the past year. No record was kept of the legal advice given to the same officials in daily informal conferences.

Ten processing-tax regulations, 3 administrative orders, 3 proclamations, and 1 certificate under the Agricultural Adjustment Act and 1 joint regulation under the Bankhead Cotton Act were prepared for the Secretary. The proclamation of the President terminating, with respect to peanuts, the floor-stock provisions of the Agricultural Adjustment Act was also prepared.

Eight public hearings were conducted pursuant to appropriate provisions of the Agricultural Adjustment Act in connection with the establishment of the rate of processing tax on various basic commodities. Summaries of the testimony heard and evidence received at those hearings as well as recommendations with respect thereto were also prepared and submitted to proper administrative officials of the Department.

Considerable time and effort were given to the preparation of amendments, and of memoranda of law in support thereof, to the Agricultural Adjustment Act, the Kerr Tobacco Act, and the DeRouen amendment (rice bill) to the Agricultural Adjustment Act. Numerous bills introduced into Congress to amend the Agricultural Adjustment Act, including the proposed flax amendments and the proposed Shipstead amendment, were given careful consideration, and report and comment were made.



Over 70 cases were brought against collectors of internal revenue and others for the collection of the refund of processing taxes paid or injunctions against the collection of processing taxes to be paid during the latter part of the fiscal year. Working closely with the Department of Justice on these cases, the Tax Section drafted all the briefs, motions to dismiss complaints, answers, and other court papers; it also prepared the evidence for trial and actually assisted the Department of Justice in the trial of the several cases which were tried on the merits. At the close of the year 450 such cases were still pending.

#### CASES OF INTEREST

The case of *Franklin Process Company v. Hoosac Mills Corporation*, in the District Court of the United States for the District of Massachusetts, involved the constitutionality of the processing tax on cotton and the corresponding floor-stocks tax on articles processed from cotton. The case arose from the disallowance of the claim of the Government filed by the Collector of Internal Revenue with the receivers for the Hoosac Mills Corporation covering the processing and floor-stock taxes referred to. The questions raised by the claim were presented to the district court on April 30, 1934, and that court rendered its opinion upholding the constitutionality of the act on October 19, 1934. The decision of the court was entered on January 4, 1935, and the claim of the collector for taxes allowed. An appeal from this decision was heard in the circuit court on April 23, 1935. At the close of the fiscal year which ended on June 30, 1935, the circuit court had not rendered its decision.

In the case of *John A. Gebelin, Inc., v. Milbourne*, in the District Court of the United States for the District of Maryland, the plaintiff sought to enjoin the Collector of Internal Revenue from collecting the hog-processing tax from it, and also to secure a declaratory judgment under the Federal Declaratory Judgments Act. The case came up for trial on the merits of the case on May 23, 1935, and at the close of the fiscal year the decision of the court had not been rendered.

With the consideration by Congress in June 1935 of numerous amendments to the Agricultural Adjustment Act, including an amendment to remove the jurisdiction of the courts to entertain any suit with respect to the refund, etc., of processing, floor-stocks, and compensating taxes imposed prior to the date of the passage of the amendments in event they should be declared to have been unconstitutionally imposed, over 65 suits were instituted during that month against the various collectors of internal revenue and others to restrain the collection of taxes assessed by the Commissioner of Internal Revenue, or, in the alternative, to secure a declaratory judgment under the Federal Declaratory Judgments Act that the Agricultural Adjustment Act was unconstitutional.

#### HEARINGS

The attorneys in charge of hearings operated under procedure prescribed in 10 series of general regulations issued pursuant to the Agricultural Adjustment Act, 8 administrative orders signed by the Secretary of Agriculture, and 9 sets of instructions from the Solicitor. The following indicates the nature and number of the more important duties performed by the attorneys in charge of this work. In addition to these, there has been a constant flow of incidental legal and administrative work incident to the calling and conduct of hearings: 131 hearings upon which notices have been issued relating to marketing agreements, codes, licenses, taxes, and miscellaneous matters; 226,180 notices of hearings mailed, 393 affidavits issued relating to hearings; 524 Government exhibits prepared; 2,097 briefs, statements, exhibits, etc., filed (in quadruplicate); 2,097 witnesses examined; 5,410 certificates issued; 1,210 authentications prepared for signature and seal of the Secretary; 95 license-violations hearings, 570 papers and exhibits drafted incident to hearings; 640 witnesses examined at violation hearings; 2,718 signed marketing agreements received and checked for legal sufficiency; and 27 orders issued by the Secretary relating to marketing agreements, licenses, etc., other than control-committee orders.

#### HEARINGS OF IMPORTANCE

Public hearings relating to a proposed marketing agreement and license for the red sour cherry industry were conducted in New York, Wisconsin, Michigan, and Utah. These hearings were well attended, and a considerable amount of heretofore ungathered and uncorrelated evidence and statistics relating to this national agricultural industry were secured, the general attitude of pro-

ducers and handlers with respect to Government regulation ascertained, and legal complications arising under an agreement of such scope given detailed consideration.

A hearing held in Washington, D. C., in connection with a proposed code of fair competition applicable to factors engaged in the buying and/or selling of raw cotton in the United States, gained a large attendance but only a slight interest in the code proposed. Greater interest was shown, however, in connection with the supplement to the code, involving the consolidation of the rules for the purchase and sale of raw cotton. Since the hearing the rules discussed have been adopted, either in whole or in part, by several of the organizations handling this commodity.

A proposed butter marketing agreement for 11 States in the Rocky Mountain and Pacific areas was discussed at public hearings held at seven different points in the principal butterfat-production areas. The agreement under discussion contained many distinctive provisions relative to the grading of, and prices to be received for, butterfat, which were intended to benefit the producer. A record was obtained which reveals the past and present conditions of the industry and how the producer has been affected. The processors, who were well represented at all the hearings, indicated generally that they were not in favor of a marketing agreement and alleged that the interests of the industry, particularly as related to the purchase of butterfat, the processing and distribution of the finished products therefrom, would be best subserved by a continuance of the then present conditions, without Government cooperation. It was also developed that a number of States have control measures governing the sale and distribution of butterfat products in intrastate commerce, which, as a rule, brought higher prices to producers and improved the quality of products for the consumer. These same States were said to be anxious, however, to obtain the aid of the Federal Government to control interstate-commerce features of the butterfat market.

A series of eight hearings on a proposed marketing agreement for early potatoes was held at central commercial production points in the South and Southeast. At practically every hearing, it was demonstrated that an agreement of some kind was advisable because of the unfavorable returns that growers had been receiving. The evidence taken reveals numerous allegedly bad conditions obtaining in the industry—share planting, undue promotion of fertilizer sales, thereby increasing production, financing of marginal growers with resultant demoralized markets, and the lack of systematized methods of distribution. Keen interest was displayed by the producers and processors who were well represented in every instance. A feature that received considerable attention at the hearings related to the problem of controlling truck shipments.

A series of hearings on a proposed marketing agreement for hops grown in the States of California, Oregon, and Washington was participated in by most of the hop growers in the area. Others attending were representatives of the United States Growers Association, major hop dealers in the East, and growers and dealers from other sections. Considerable opposition to any marketing agreement was prevalent, but before the close of the first hearing the sentiment changed rapidly to one of cooperation, the consensus of opinion being in favor of a workable marketing agreement.

Other important hearings relating to California rice, sugar beets, Florida citrus fruits, Texas citrus fruits, asparagus, turpentine, tomatoes, peaches, grain exchanges, and milk were held, resulting in many benefits, even though in some instances marketing agreements were not reached, nor licenses issued. The study of the commodity or industry from a Nation-wide scope by the members of the industry frequently produced a better relationship in the industry and was instrumental in enhancing trade conditions and eliminating unfair trade practices, the general result being to stabilize the affected commodity.

#### LEGISLATION

In the fall of 1934 a draft of a bill was prepared, containing proposed amendments to the Agricultural Adjustment Act. The draft contained amendments which were primarily technical in nature and largely devoted to improvements in the procedure for the issuance and judicial review of licenses. The draft also contained a section empowering the Secretary of Agriculture to inspect the books and records of licensees, and embodied the so-called "ever-normal granary plan." The bill, as drafted, was introduced on February 12, 1935, in the House of Representatives by Marvin Jones (H. R. 5585) and in the Senate by Senator Ellison D. Smith (S. 1807). Hearings were held on the House bill before the



House Committee on Agriculture and Forestry during the early part of 1935, attended by the Secretary of Agriculture, the Administrator of the Agricultural Adjustment Administration, and the Solicitor.

About the middle of March 1935 the House Committee on Agriculture went into executive session to consider the bill H. R. 5585. The Solicitor's Office was represented at the executive session. Various amendments to the House bill adopted by the committee at these hearings were embodied in a confidential committee print, dated March 26, and resulted in the introduction by Mr. Jones on March 28 of a new bill (H. R. 7088). The House committee, by a close vote, adopted a motion to report this bill to the House, but no such action was ever taken, and the bill was again considered in executive session in April 1935.

As a result of the executive session held in April, a third bill was introduced by Mr. Jones on April 24 (H. R. 7713). The committee adopted a motion to report this bill to the House, and it was so reported on April 30 (Rept. No. 808).

Before the bill (H. R. 7713) came up on the calendar, further executive sessions were held by the House committee and led to the introduction by Mr. Jones on May 14 of a fourth bill (H. R. 8052). This bill was reported to the House on May 15 (Rept. No. 952), and became No. 317 on the Union Calendar. The bill in the form in which it was put upon the calendar was much more extensive than the bill submitted by the Agricultural Adjustment Administration and contained many limitations upon the power to issue licenses, various further technical amendments, a section authorizing the imposition of quotas upon imports of agricultural commodities where such importation was hampering a program adopted under the act, and a section which appropriated 30 percent of the annual receipts from customs duties, primarily for the purpose of encouraging the exportation of agricultural commodities. This bill was never called up for debate in the House of Representatives.

The Senate Committee on Agriculture and Forestry went into executive session to consider the bill S. 1807 in the early part of April 1935. The executive session in the Senate upon this bill lasted only 2 days, and only relatively unimportant technical amendments were made. The Agricultural Adjustment Administration was represented at the executive session by the Secretary of Agriculture, the Administrator, and other officials of the Agricultural Adjustment Administration, and an attorney from this Office. The Senate committee adopted a motion to report the bill to the Senate, and it was so reported on April 24 (Rept. No. 548), and became no. 571 on the Senate calendar.

The bill was called for debate on the floor of the Senate on May 27. The debate, however, did not center around the provisions of bill S. 1807 but upon an amendment in the nature of a substitute proposed by Senator Smith, which was identical with the House bill H. R. 8052. At the request of Senators Smith and Bankhead, the Solicitor's Office rendered technical assistance to the chairman and members of the Senate committee on the floor of the Senate during the debate. In the course of the debate the decision of the Supreme Court in the case of *Schechter v. United States*, in which the National Recovery Act was held unconstitutional, was announced, and as a result of this decision the bill S. 1807 was recommitted to the Senate Committee on Agriculture and Forestry the following day.

Following the decision in the *Schechter* case, an extensive redraft of House bill, H. R. 8052, was made by the Agricultural Adjustment Administration, assisted by the Solicitor's Office, with a view to avoiding the constitutional difficulties which were emphasized in the decision in the *Schechter* case, and, incidentally, the developing of a more workable statute than was embodied in H. R. 8052. The bill as redrafted by the Agricultural Adjustment Administration was submitted to the House Committee on Agriculture and Forestry early in June and was embodied in a committee print dated June 5, 1935. No formal hearings were held on the redrafted bill, and the House committee proceeded immediately to consider it in executive session. Various amendments were made by the committee, and embodied in committee prints dated June 10 and June 12. At the end of the executive session, Mr. Jones introduced on June 14 a new bill, H. R. 8492, and the committee on the same day unanimously adopted a motion to report the bill to the House, and the bill was so reported on June 15 (report no. 1241), and became no. 426 on the Union Calendar. This bill passed the House of Representatives on June 18, and was sent to the Senate and referred to the Senate Committee on Agriculture and Forestry on June 19. The Senate committee held no formal hearings on the bill and proceeded to consider it in executive session. The Agricultural Adjustment Administration was represented at the executive session by the Administrator and other officials



of the Agricultural Adjustment Administration and by various attorneys of the Solicitor's Office. The bill was still being considered in executive session at the close of the fiscal year on June 30.

Early in 1935, a bill was drafted for the control of potato marketing, in cooperation with representatives of the potato producers and the general crops section of the Agricultural Adjustment Administration, and was introduced in the House of Representatives by Mr. Lindsay Warren (H. R. 6082). Subsequently, at the request of a subcommittee of the House Committee on Agriculture, the bill was redrafted and introduced by Mr. Warren on May 7 (H. R. 7395). This was its status at the close of the year.

A bill containing various technical amendments to the Kerr Tobacco Act was prepared at the request of the tobacco section and Mr. Kerr, and was introduced in the House of Representatives by Mr. Kerr on June 26, 1935 (H. R. 8677).

Various other bills, resolutions, and draft amendments to the various statutes administered by the Agricultural Adjustment Administration, of which no precise record has been kept, were drafted by the Office at the request of the Agricultural Adjustment Administration or of Senators or Members of Congress from time to time during the fiscal year.

#### LAND POLICY

This phase of the legal work of the Office consisted chiefly in cooperating with the Federal Emergency Relief Administration in administering the submarginal-land-purchase program. In carrying out this work 12 written opinions were prepared and issued.

The report on land by the National Resources Board was prepared under the supervision of the Office, and a complete survey was made of all agencies in the Federal Government engaged in land acquisition, land administration, and land planning. As a result, a 100-page mimeographed memorandum was issued, which shows that there are 39 agencies in the Federal Government engaged in this field. Each of the 39 agencies is discussed, and information as to each is classified. The memorandum was widely distributed to agencies in the Government, to universities, libraries, and public foundations.

A complete survey and digest was made of all State statutes of cession and consent to determine whether the United States or the several States would exercise general civil and criminal jurisdiction over lands acquired in various Federal land-settlement programs, and a study was made of all State legislation in the fields of rural zoning and State planning to indicate the effect which such State legislation and administrative programs might have upon Federal land-settlement and land-development programs. This study is being continued.

Five opinions were prepared with reference to problems raised by the Soil Conservation Service, and a standard form of articles of association for the organization of voluntary soil-conservation associations was prepared and made available to the Service for use in encouraging the organization of associations throughout the country. Work is now in progress on drafting a standard State soil-conservation districts law for adoption by State legislatures for the organization of soil-conservation districts in the various States.

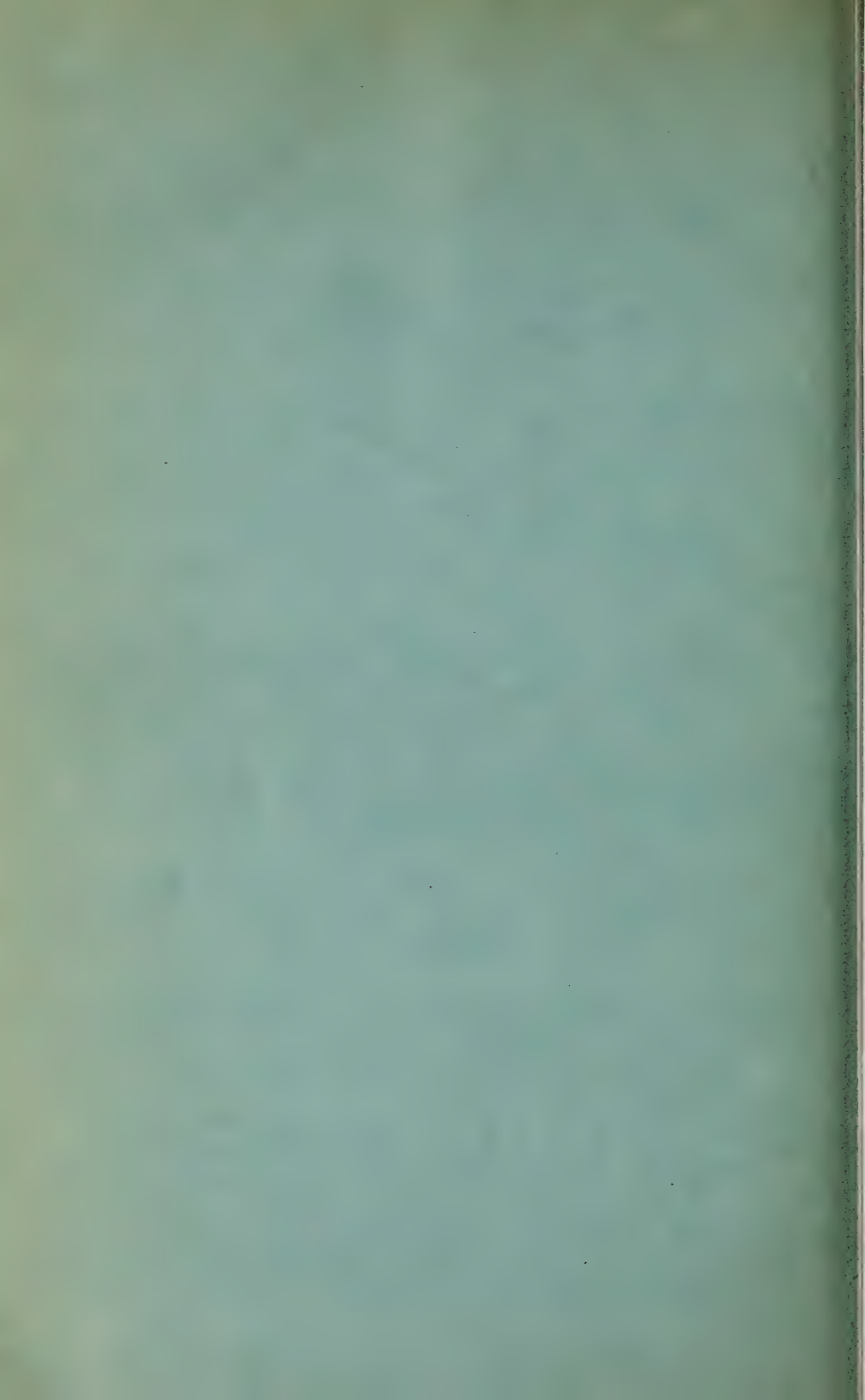
Surveys of existing and proposed legislation concerning land policy and land programs were made and reported on. Special reports on particular Government programs and proposed bills in the field of land administration and land policy were also made. A study is now being made of the land programs of the Resettlement Administration and other Federal agencies to coordinate their programs with the work of the land-policy committee.

A study was made of the possibility of using the purchase of easements by agencies of the State and Federal Governments as an instrument for control of land use. The study resulted in the tentative conclusion that the device was not a dependable one. A modification of this proposal, calling for the adoption of State legislation authorizing the execution by Government agencies of contracts with landowners regulating land use, providing for the recordation of such contracts, and making the provisions of such contracts binding on subsequent purchasers is being incorporated in the State soil-conservation districts law now being drafted.

On the subject of farm tenancy, reports were drafted for the signature of the Secretary on H. R. 5603 and S. 2367.

Considering the nature of the work of the Office, it was current at the close of the year.







# REPORT OF THE CHIEF OF THE WEATHER BUREAU, 1935

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UNITED STATES DEPARTMENT OF AGRICULTURE,  
WEATHER BUREAU,  
Washington, D. C., August 13, 1935.

HON. HENRY A. WALLACE,  
*Secretary of Agriculture.*

DEAR MR. SECRETARY: I submit herewith a report of the work of the Weather Bureau during the fiscal year ended June 30, 1935.

Sincerely yours,

W. R. GREGG, *Chief.*

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## INTRODUCTION

In the last annual report a brief account was given of the action that had been taken in the initiation of a more progressive and forward-looking program in meteorological service, along the lines recommended in a report by the Science Advisory Board. The most important recommendation was that relating to air-mass analysis and its more extensive and detailed use in forecasting. Other recommendations were largely designed to assist in the carrying out of this one. They include training of personnel, an extension of the airplane-observation program, and an increase in the number and greater detail in the character of surface observations. Since no additional funds were provided for the purpose, there was no recourse except to make a modest beginning in the realization of these objectives through reorganization and adjustment of existing service and cooperation with various Government departments and with other agencies. Some progress has resulted, and an account of it will be given in later sections of this report. First, however, it is believed well worth while to comment briefly on the value and the indispensability of cooperation in the organization and maintenance of meteorological service.

## COOPERATION A VITAL FACTOR IN METEOROLOGICAL SERVICE

Probably in no other branch of the Federal service is cooperation a more vital factor than in the Weather Bureau. Generally speaking, it is of mutual benefit to the Bureau and to the cooperating agencies. It may be considered under three chief heads, international, governmental, and nongovernmental.

### INTERNATIONAL COOPERATION

One of the finest examples of international cooperation and good will exists in connection with the science of meteorology. For more than 60 years the directors of national meteorological services have been meeting regularly to exchange ideas and information, and especially to secure harmony and standardization in important fields where otherwise effective cooperation would be impossible. Meteorology is essentially world-wide in its scope. No country, however large its geographic area, is of sufficient size to be independent of other countries in providing its people with an adequate weather service.

The history of government-supported meteorological organizations covers a period of about 75 years. Institutions concerned in some degree with meteorology existed earlier, but they had no official status. Several conferences of officials affiliated with government meteorological services were held in Europe in the early seventies, but a permanent organization was first effected at Rome

in 1879. At the present time, there are 105 meteorological or closely related scientific services organized through their directors into what is known as the "International Meteorological Organization." Actually, only 54 countries are represented owing to the fact that in some instances several organizations operate independently of each other, although supported by the same government. The International Meteorological Organization is subdivided into commissions, each under the direction of a president. These subcommissions deal with more or less distinctive phases of meteorological work. Only directors can be members of the major organization, but the subcommissions are composed of an unlimited number of technical employees of the national services and a few outstanding scientists who have no official affiliations. Membership in the subcommissions, each of which includes one or more directors, now totals about 260 persons.

The International Meteorological Organization is wholly voluntary and is devoid of control by national treaties or conventions. Its recommendations are expressed in the form of resolutions, adherence to which is only a moral obligation. Meetings are held sexennially. This year (1935) the regular sexennial meeting will be held at Warsaw, Poland. Subcommissions meet as frequently as circumstances warrant, usually every 2 or 3 years. Most of them will meet this year at Danzig or Warsaw in September and, according to custom, just prior to the major meeting. The representatives from the United States Weather Bureau will be the Chief of the Weather Bureau and the Chief of the Division of Climate and Crop Weather.

Details of the cooperation accomplished through the International Meteorological Organization and its subcommissions are too numerous to be specified and described here. At the last sexennial meeting, held in 1929 at Copenhagen, 109 resolutions were adopted, covering a wide range of activities. Although many of them did not directly concern the United States Weather Bureau, all had international cooperative aspects and some of them were of great importance to every national service.

Exchange of observations is the most important feature of international cooperation. This is effected principally by radio, but cable and telephone are employed in some instances. Collateral features of the exchange are internationally standardized definitions, codes, etc., without which intelligent application of the data would be impossible. Cooperation with Canada is most complete. From a meteorological standpoint, there is no boundary line. Most Canadian reports are received at United States forecast centers as promptly as at Toronto and, similarly, observations made at United States stations are as promptly sent to Toronto. Exchange arrangements also exist with Mexico, the Philippines, and the Far East, and with the several independent meteorological organizations in the West Indies.

Twice each day, at 11 a. m. and 11 p. m., eastern standard time, bulletins are transmitted by radio directly from the Weather Bureau Office in Washington through the Navy radio stations at Arlington and Annapolis for the benefit of European meteorological services. These bulletins contain about 100 reports representative of weather conditions in North America and reports from ships in the western Atlantic. Correspondingly, twice daily, about 5 a. m. and 5 p. m., eastern standard time, bulletins containing about 100 European land-station observations and reports from ships in the eastern Atlantic are broadcast from the powerful Rugby station in England for the benefit of meteorological services in North America. These bulletins are copied at United States Navy radio stations and are made available immediately to the Weather Bureau.

#### COOPERATION WITH OTHER GOVERNMENT BUREAUS AND DEPARTMENTS

Every possible effort is made to take full advantage of the facilities of all agencies of the Government in securing and transmitting weather observations from both land and sea. In return, forecasts and warnings based on these data and on the Weather Bureau's own far-flung network of reporting stations are made available to those organizations.

#### DEPARTMENT OF AGRICULTURE

The bureaus in the Department of Agriculture with which cooperation is most extensive are the Forest Service, Office of Experiment Stations, Agricultural Economics, and Agricultural Engineering.



The forest fire-weather-warning service is one of the most active projects of the Weather Bureau. Its primary purpose is to issue weather forecasts for the large forested areas of the country during the season of fire hazard and especially to warn of weather conditions which favor the inception and spread of forest fires. For this purpose daily observations of weather conditions in the forests themselves are required. Meteorological stations, equipped with necessary instruments, are established therein. There are at present nearly 700 stations of this class. Employees of the Forest Service, State forestry services, and in some instances private owners of large tracts, mostly at look-out and ranger stations, serve as observers. They forward the reports by telegraph or telephone to the Weather Bureau offices from which the fire-weather warnings are issued.

In California there is a unique form of cooperation by the Forest Service in supplying a truck equipped with radio and meteorological apparatus for the use of the Weather Bureau in visiting large fires and furnishing weather reports and forecasts directly to those who direct the work of fighting the fires and preventing their spread. This subject is presented more fully later.

Lightning causes more fires in the forests of the far Western States than any other single agency. Forecasting of lightning storms is of great importance in enabling those charged with protection of the forests to make preparations for combating such fires as they occur. Study of lightning statistics with the general weather conditions accompanying thunderstorms is essential to successful forecasting. Lookouts, rangers, and other forestry employees record lightning occurrences at several hundred places in the forests and make them available to the Weather Bureau for study.

The Forest Service cooperates very actively also in the measurement of snow depth in the mountainous sections of the western part of the United States. This is a project of considerable difficulty, and the cost of establishing special stations at high levels would be very large. Many of the measurements are made by forest rangers as a part of their regular duties without any appreciable additional cost to the Government.

The Office of Experiment Stations cooperates chiefly by providing weather observations that are made by its field personnel and transmitted to the Weather Bureau for use in its weather and crop service. The observations are made daily and are summarized each week as a basis for the Weekly Weather and Crop Bulletin which makes possible a running appraisal of the development of crops as influenced by weather conditions.

Cooperation is maintained also with the Bureau of Agricultural Economics in its crop-reporting work. Information as to current and past weather conditions as affecting growing crops and farm operations, collected through the Weather Bureau's extensive network of weather-crop observers and correspondents, is furnished at frequent intervals for use in the preparation of the regular monthly crop-condition report issued by the Crop Reporting Board. In some cases weekly weather and crop bulletins are issued jointly by the Weather Bureau and the State statisticians' offices of the Bureau of Agricultural Economics.

Active cooperation with the Bureau of Agricultural Engineering is of comparatively recent date. Under the terms of an agreement entered into by the two Bureaus and approved by the Secretary of Agriculture, the Weather Bureau will make available to the Bureau of Agricultural Engineering such mountain snowfall data and general run-off forecasts as that Bureau may need in providing more detailed forecasts for specific irrigations projects. On its part the Bureau of Agricultural Engineering will furnish promptly to the Weather Bureau all data that it collects. These, together with records obtained by other agencies, will be published by the Weather Bureau as heretofore. Moreover, the two Bureaus will cooperate in the development of new equipment and methods of measurement and in other investigations in this very important project.

#### WAR DEPARTMENT

The War Department cooperates with the Weather Bureau in a very complete way, chiefly through its Signal Corps, Air Corps, and Engineer Corps.

Meteorological observations are virtually useless in current service unless immediately transmitted to a wide network of stations where they can be promptly charted, analyzed, and issued in the form of bulletins and forecasts. While this is taken care of in considerable part through contract with commercial companies, there are some regions where such facilities are lacking



and in these cases the radio stations of the Signal Corps transmit weather observations regularly and promptly for use either locally or to the United States for inclusion in the Weather Bureau's general system of reports. For example, from 2 to 6 observations are made daily at 15 places in Alaska where Signal Corps radio stations are located. These reports are utilized in connection with the weather information and forecasts furnished by the Weather Bureau for airway operations in that Territory. Reports from 10 of the stations are transmitted twice daily to Seattle for distribution to Weather Bureau offices in the States. Again, weather bulletins containing observations taken at meteorological stations in Mexico and broadcast twice daily from Chapultepec, near Mexico City, are copied by the Signal Corps station at Marsh Field, Calif., and are made available to the Weather Bureau for distribution to its forecast centers and airway stations in the western part of the United States.

The Signal Corps cooperates also in providing upper-wind data from pilot-balloon soundings made at a number of military flying fields. These observations are used by the Weather Bureau to supplement its own. The cooperation in this case is not one-sided, as the meteorological service of the Signal Corps is similarly supplied with the complete network of Weather Bureau reports, both surface and upper air, in connection with the issuance of forecasts and warnings for purely military purposes.

A notable advance in cooperation was accomplished during the past year in connection with the organization of a country-wide network of airplane-observational stations. One of the participants in this program is the Air Corps. At eight of its flying fields daily flights are made, weather permitting, to a height of approximately 17,000 feet. A more extended account of the work is given later. The cost of a commercially operated station of this type is about \$10,000 per year, whereas the cost to the Air Corps is very slight, since pilots and equipment are already available and the flights are made as a part of the pilots' training.

The Engineer Corps cooperates with the Weather Bureau in connection with its river and flood service. Readings are made of river stages at about 100 of its river gages, and these are made immediately available for use in daily forecasts of all principal rivers throughout the country. These are of special value at times of floods. The Weather Bureau likewise furnishes its own data to the Engineer Corps as an aid in its operations.

#### NAVY DEPARTMENT

Cooperation with the Navy Department is similar, in many respects, to that with the War Department. Upper-air data of wind direction and velocity are secured at a number of pilot-balloon stations at flying fields of the Bureau of Aeronautics and transmitted to the Weather Bureau. Moreover, at eight of these fields daily airplane flights are made as a part of the Bureau's regular aerological program. In addition, frequent airplane observations are made from naval vessels in coastal waters and transmitted promptly to the Weather Bureau.

The Office of Communications provides cooperation of outstanding value and importance, both in the collection of surface reports transmitted from naval and commercial ships, and in the dissemination of bulletins and forecasts to marine interests, to foreign countries, and to the public generally. Only a brief summary can be given here.

About 10,000 observations from ships at sea are collected each year by naval radio stations.

Mexican and Central American reports are transmitted by the radio station of the Pan American Airways Co. at Brownsville, Tex., to the naval radio station at Pensacola, Fla., and thence by the latter to the Weather Bureau at Washington. This is a twice-daily service.

Observations are made at naval radio stations at 4 isolated places, 1 in Alaska, 2 in the Pacific, and 1 in Cuba, and transmitted to designated Weather Bureau offices in the States.

Observations taken in far eastern areas (China, Japan, Philippines, etc.) are collected at Manila and transmitted daily by naval radio to the Weather Bureau offices at San Francisco and Washington. The U. S. S. *Houston*, operating in the Far East, collects weather reports by copying weather bulletins broadcast from stations and from ships in those waters. These reports are also repeated to the Weather Bureau offices in San Francisco and Washington.

Similarly the naval radio station at Dutch Harbor, Alaska, copies weather reports broadcast from radio stations in eastern Siberia and transmits them to Weather Bureau offices in Seattle, San Francisco, Juneau, and Washington.

Without such cooperation, it would be difficult or impossible to obtain highly valuable reports from these distant or isolated areas.

Extensive broadcasts of weather information from the United States, Alaska, Canada, West Indies, and from ships are made two or more times daily for the benefit of marine, agricultural, and aviation interests. The broadcasts include forecasts and warnings. Some 25 naval stations participate in this program, but the most extensive bulletins are those broadcast from Washington (NAA and NSS) and San Francisco (NPG) by remote control directly from the Weather Bureau offices. These two bulletins give data in such completeness as to enable vessel masters to prepare weather maps on shipboard.

An important feature of the Weather Bureau's work in ocean meteorology is its statistical section. Weather observations are made on large numbers of ships of all nations. These are entered on standard forms and sent by mail to the central office at Washington, where they are summarized and the results turned over to the Hydrographic Office for publication on pilot charts and in pilot books. The main items of information are the average wind direction and force; average barometric pressure and tracks of storms; summaries of fog conditions; and, more recently, special summaries in great detail, applicable to the planning and conduct of ocean aviation.

#### TREASURY DEPARTMENT

The Coast Guard cooperates very effectively and extensively with the Weather Bureau in several ways. At about 50 life-saving stations storm warnings are displayed, whenever issued by the Bureau. These displays consist of flags by day and lights at night.

Weather observations are made by employees at numerous life-saving stations on the Atlantic and Gulf coasts and on the Great Lakes and transmitted to Weather Bureau offices over Coast Guard telephone lines and by radio. This cooperation is of inestimable value in connection with the issuance of hurricane warnings. For the most part the Coast Guard stations are located at isolated places on the coast from which observations are especially needed and from which reports, especially of tides and swells, could not otherwise be obtained.

The Coast Guard cooperates also during the ice-patrol season, by furnishing observations from its cutters, including in recent years upper air wind data from pilot-balloon soundings.

#### DEPARTMENT OF COMMERCE

Cooperation with the Department of Commerce is provided chiefly by the Bureau of Air Commerce, the National Bureau of Standards, and the Bureau of Lighthouses.

The Bureau of Air Commerce has organized an extensive system of communications, both radio and teletype, along all of the principal airways in the country. At numerous points on these airways where it is necessary to have weather observations made, although there is no need for the assignment of highly trained meteorologists, employees of the Bureau of Air Commerce make the observations and transmit them to Weather Bureau offices. Reciprocally, at points where meteorologists are assigned they assume the duty of operating the communications facilities, including in many cases the broadcasting of weather reports and forecasts. A great advance has been made during the past year in this cooperation which is now close and effective and altogether eliminates unnecessary duplication of personnel and cost throughout the airway service.

The National Bureau of Standards provides valuable cooperation in the calibration of Weather Bureau equipment, the facilities of the wind tunnel being made available for this purpose. That Bureau also furnishes material aid in testing supplies of various sorts, to determine whether or not they meet the specifications set up in securing bids.

Cooperation with the Bureau of Lighthouses is similar to that with the Coast Guard. At 17 lighthouses storm signals—flags by day and lights at night—are displayed whenever received from the Weather Bureau.



## POST OFFICE DEPARTMENT

Forecasts are telegraphed each week day to postmasters who are supplied with a simple stamping outfit composed of rubber type. The forecasts are stamped on addressed cards and distributed by mail in the nearby territory. In other cases the forecasts are posted in the post offices or are given out on telephone call.

## DEPARTMENT OF THE INTERIOR

The Geological Survey and the Weather Bureau both maintain river gages. In the last 2 years a successful effort has been made by these two services to coordinate the work in a way that will prevent overlapping and will make it possible to use the same gages at approximately 60 stations, thereby decreasing the cost of installation and maintenance and giving an improved service. The Geological Survey is interested largely in the amount of water available for consumptive use, while the particular interest of the Weather Bureau is in forecasting river stages from day to day and issuing flood warnings. The objectives are different, but the basic data necessary in obtaining them are the same. A large number of the common gages are checked and repaired by the Geological Survey, the Weather Bureau paying the salaries of the observers. Also, the Survey furnishes this Bureau with rating curves and is in turn furnished telegraphic reports of heavy rains which enable the engineers to reach isolated streams promptly in order that they may make observations of flood run-off.

Other cooperating agencies of this Department are the Bureau of Reclamation, the Bureau of Indian Affairs, and the National Parks Service, all of which furnish daily, and at times more frequently, observations during the season of fire hazard in forested regions. Equipment is furnished by the Weather Bureau. The observations are useful in supplementing the Bureau's own data as a basis for fire-weather forecasts.

The Geological Survey and the Bureau of Reclamation also make evaporation measurements for the Weather Bureau at some of their stations in arid and semiarid regions.

## COOPERATION WITH NONGOVERNMENTAL AGENCIES

It is quite out of the question to give anything like a complete account of the cooperation that the Bureau receives from thousands of individuals and hundreds of organizations of various kinds. Effort will be made merely to list some of the outstanding cases.

Data of high statistical value are provided in observations made at about 4,500 stations throughout the United States and its possessions. In some cases the cooperating agency is a commercial firm, a railroad, a power company, an agricultural college, or a university, but for the most part the observers are individuals whose only compensation is the assurance that they are contributing to a most worthy project, that of making possible an accurate appraisal of the climatic characteristics of all parts of the country.

Of the same type is the cooperation received from the masters of vessels of every maritime nation, whose observations, when summarized, likewise define the climate of the seas. Some 1,300 ships participate in this program.

More recently the upper air is receiving attention, and we have a constantly enlarging cooperation from air-transport companies which furnish, chiefly through their pilots, highly valuable information regarding weather conditions encountered in their flights.

More than 350 commercial radiophone stations throughout the country provide a valuable service in broadcasting forecasts and other information without cost to the Government. These radio broadcasts and the newspapers constitute the most extensive and effective method of distributing forecasts and warnings. Many millions of people are reached through these agencies.

## MONETARY VALUE OF COOPERATION

It is impossible to give even an approximate estimate of the cost saved to the Government through the utilization by the Weather Bureau of the facilities of other bureaus and departments and through outright cooperation by individuals and organizations outside of the Government. The figure would be well up in the millions. For instance, the cost of operating the 4,500 cooperative



climatological stations, if the observers were paid only \$5 per month, would be \$270,000 per year.

The observations made by the personnel of the Bureau of Air Commerce along the airways as a part of their regular duties would cost approximately \$500,000 each year, if observers were employed for that service.

The cooperation of the War and Navy Departments in the airplane-observational program saves in the neighborhood of \$150,000 per year.

Although other cases of cooperation outlined in this report would individually yield smaller savings than those cited, the total would be impressive. Cooperation yields many other benefits, however, in addition to the financial. It is more vital to the efficient organization and maintenance of meteorological service than is the case with any other public endeavor. It will be broadened and extended still further as circumstances warrant.

### WEATHER OF 1935 MORE FAVORABLE THAN 1934

The severe and unprecedented drought of 1934, which seriously affected agriculture in the United States, did not carry over to an appreciable extent into the 1935 crop-growing season. Following the extremely hot, dry summer of last year, the fall months brought timely rains which produced soil moisture sufficient to permit the seeding and to promote the early growth of winter grains in practically all sections from the Great Plains eastward, except in the southwestern Plains where moisture continued insufficient.

In the western mountains, the winter months had much heavier snowfall than during the preceding winter, assuring a better water supply for irrigation than was available for the summer of 1934. Thus, except in the southwestern Plains, the crop-growing season of 1935 began under much more favorable conditions than that of 1934. The Southwest, comprising principally southwestern Nebraska, western Kansas, southeastern Colorado, western Oklahoma, northwestern Texas, and northeastern New Mexico, continued extremely dry till about the middle of May when heavy rainfall relieved the situation. Previous to the rains, there was in this area extensive and very destructive soil drifting by wind action, and the most severe, frequent, and widespread dust storms ever experienced in this country occurred. Rainfall had been deficient for a long time, and the soil became extremely dry, thus facilitating drifting and dustiness with any appreciable wind movement. On several occasions during March and April considerable dust was carried through the atmosphere as far east as the Atlantic coast.

During the spring months, moisture, as a rule, was ample over nearly all the principal agricultural areas of the country. In fact, frequent heavy rainfall kept the soil entirely too wet over large areas of the central valleys which seriously delayed spring plantings in many sections. In addition, abnormally cool weather retarded germination and growth, further contributing to the lateness of the spring-planted crops. Damaging floods occurred in some places, especially over a belt extending from the lower Ohio Valley westward to southwestern Nebraska and eastern Colorado; many hundreds of thousands of acres of bottomland crops were destroyed. However, over most of the Midwest, where severe drought prevailed in 1934, the generous rainfall of the spring of 1935 was very favorable, especially in the central and northern Great Plains, and in general the weather was much more favorable than during the preceding year. By the beginning of summer the effect of the 1934 drought had largely disappeared, fewer than normal agricultural localities being in need of moisture. However, July was extremely warm, and precipitation was scanty in many sections of the country, with the result that, by the close of that month droughty conditions had become reestablished over large areas of the Great Plains and Rocky Mountain States, being especially severe in the southern plains.

Rainfall for the first half of 1935 (January-June) was in marked contrast to that of 1934. For the country as a whole, the 1934 percentage of normal for this period was 79 and the 1935 average 100 percent of normal. Table 1 shows, by State averages, the percentage of normal precipitation for the several States for the first half of 1935, and also the percentages of the 1935 averages as related to those of 1934 as a base.

TABLE 1.—*Precipitation by States, January-June 1935*

State	Percent- age of normal	1935 compared with 1934	State	Percent- age of normal	1935 compared with 1934
	<i>Percent</i>	<i>Percent</i>		<i>Percent</i>	<i>Percent</i>
Alabama.....	97	103	Nevada.....	112	168
Arizona.....	146	242	New England.....	106	99
Arkansas.....	145	180	New Jersey.....	81	86
California.....	106	197	New Mexico.....	108	167
Colorado.....	110	164	New York.....	94	108
Florida.....	79	59	North Carolina.....	89	87
Georgia.....	84	80	North Dakota.....	104	202
Idaho.....	87	106	Ohio.....	94	155
Illinois.....	130	242	Oklahoma.....	132	181
Indiana.....	111	199	Oregon.....	84	109
Iowa.....	113	219	Pennsylvania.....	86	114
Kansas.....	120	179	South Carolina.....	71	70
Kentucky.....	148	211	South Dakota.....	104	195
Louisiana.....	118	106	Tennessee.....	117	181
Maryland and Delaware.....	109	110	Texas.....	130	140
Michigan.....	91	148	Utah.....	106	187
Minnesota.....	104	165	Virginia.....	112	114
Mississippi.....	113	127	Washington.....	100	108
Missouri.....	144	249	West Virginia.....	120	159
Montana.....	78	103	Wisconsin.....	98	140
Nebraska.....	123	230	Wyoming.....	105	146

## STUDIES IN AIR-MASS ANALYSIS AND ITS PRACTICAL APPLICATIONS

The Weather Bureau, if it would not fall hopelessly behind similar institutions elsewhere, must keep informed of every increase in our knowledge of scientific or theoretical meteorology, a requirement that entails continuous and extensive reading and study. It is equally imperative that this Bureau itself also make additions to our understanding of atmospheric and weather phenomena. Finally, the Weather Bureau must keep fully informed of all meteorological arts—all applications of the science of meteorology to practical needs of every kind, in planting, harvesting, shipping, from protection, forest-fire warnings, flood warnings, and the thousand and one other things, great and small, that affect our prosperity, our comfort, and our health. Such of these arts as would benefit this country the Weather Bureau must and does adopt and then, if need be, adapts them to our own conditions.

One of the most conspicuous and useful services of meteorology is that of forecasting the weather. The common method of making these forecasts is to picture symbolically on a map the existing weather at a given instant over a greater or less territory, and then to deduce from this synoptic map what the weather will be at various places during a specified coming period, such as 12, 24, or 36 hours from the time the charted observations were made. Until recent years the only map of this kind in common use consisted essentially of isobars (lines of equal pressure, reduced to sea level), isotherms (lines of equal atmospheric temperature near the surface), and symbols for cloudiness, wind direction and velocity, and such other weather facts as might be available and helpful to the weather forecaster. All the time, however, it was recognized that while some weather changes are home-made, by local heating and cooling, most of them are owing, mainly, to the replacement at a given locality of air in one condition by air of some other condition, and to the interactions of these different masses of air with each other. Clearly, then, a synoptic map giving the boundaries, or fronts, of the different masses of air over a given large territory, together with the states and conditions of these masses and the directions and speeds of their movements, also could be used, like the isobaric maps, in forecasting the coming weather. It is not obvious, however, from which of the two synoptic maps, the isobaric or the frontal, one could most clearly foresee the coming weather. Presumably some combination of the two, such as the one which for years has been evolving at the Weather Bureau, would be better than is either alone.

But what would be the best combination that at the same time is practicable, that does not require data too expensive to obtain, and that can be so quickly mapped as to insure a well-considered forecast very soon after the observations on which it is based were made? This important question the Bureau is trying



to answer as speedily as may be consistent with caution. To this end three young men, highly trained in the technique of constructing synoptic frontal maps, are making such charts at the central office of the Weather Bureau from both the morning and the evening observation for the entire United States and adjacent territory. These charts are the subjects of four round-table discussions every week with those of the Bureau's staff who are engaged in actual forecasting, and a few others who, though not forecasters, are familiar with the underlying theories. Much benefit has resulted to all concerned from these free discussions, and frankly searching, though always constructive, criticisms.

Work in this line is progressing. A reasonably successful system of forecasting must not be altered unless and until it is doubly certain that the proposed alteration is really an improvement. But immediately an improvement is clearly demonstrated the means of making it effective must and will be found.

### AIRPLANE OBSERVATIONS AND THEIR USE IN FORECASTING

In 1931 airplanes were substituted for kites. The number of upper-air observations by airplanes available to the forecaster was increased to 25 within the last 2 years. These observational data have been employed in diagnosing the vertical extent and structure of the cold- and warm-air masses that cause and maintain our cyclonic and anticyclonic systems. Temperature-height graphs are prepared daily at each of the district forecast centers for all of the airplane stations received. At each point of inflection of the temperature curve, readings of relative humidity are entered. From these graphs it can readily be seen where the humidities at the usual cloud and precipitation levels are increasing and what the temperature lapse rates are in such regions.

In addition, they permit an estimate of the slope of the frontal surfaces which separate the air masses. Information of this kind with the aid of the pilot-balloon data, which consist of wind velocities and directions, aids the forecaster in determining when and where precipitation will occur.

At present it is universally recognized that any appreciable precipitation is caused by the lifting of air masses, which results in decrease in temperature. If this lifting and resultant decrease of temperature are carried far enough, precipitation will ensue. The problem is to tell just how far this lifting will be carried. It may be brought about by frontal action either along the cold front or warm front, by thermal convection, where no front is involved, or by orographic action. To assist in determining this question in the particular case, vertical cross sections of specific humidity and potential temperature can be drawn. Graphs in the form of adiabatic charts, tephigrams, and emagrams can all be prepared from data obtained from airplane ascents. From several of these, but probably more readily from the emagram, can be determined the amount of frontal lifting required to produce precipitation. If no fronts are present, the probable maximum temperature for the afternoon may be determined from the emagram, which indicates how much afternoon heating will be needed to cause instability and thunderstorms. In fact we may say that data obtained from the airplane observations are enabling us to tell more positively whether or not precipitation will occur and to evaluate more definitely the physical causes which operate to bring it about.

### CONSOLIDATION OF METEOROLOGICAL AND COMMUNICATION ACTIVITIES AT AIRPORT STATIONS

During the past year the Weather Bureau and the Bureau of Air Commerce mutually agreed to combine the meteorological and communication activities at airports wherever practicable with a view to improving efficiency and effecting all possible economies. Arrangements were made to combine the services at the following 35 airports:

Abilene, Tex.  
Albuquerque, N. Mex.  
Amarillo, Tex.  
Bellefonte, Pa.  
Big Spring, Tex.  
Boise, Idaho  
Boston, Mass.  
Buffalo, N. Y.  
Charleston, S. C.  
Cincinnati, Ohio  
Columbus, Ohio  
Detroit, Mich.

Elko, Nev.  
Fresno, Calif.  
Greensboro, N. C.  
Indianapolis, Ind.  
Jackson, Miss.  
Kingman, Ariz.  
Kylertown, Pa.  
Medford, Oreg.  
Memphis, Tenn.  
Moline, Ill.  
Murfreesboro, Tenn.  
North Platte, Nebr.

Oklahoma City, Okla.  
Pasco, Wash.  
Pendleton, Oreg.  
Phoenix, Ariz.  
Reno, Nev.  
Richmond, Va.  
Rock Springs, Wyo.  
San Diego, Calif.  
Spartanburg, S. C.  
Wichita, Kans.  
Winslow, Ariz.



At large centers where weather maps and meteorological personnel were needed to render a specialized service, the Weather Bureau personnel was retained and the Bureau of Air Commerce personnel reduced. Under this arrangement the Weather Bureau personnel is now engaged to a considerable extent in communication work. At other airports, where the demand for weather maps and meteorological advice was not great, the Weather Bureau personnel was withdrawn. The pilot-balloon work was moved to the Weather Bureau office in the city, or to some nearby point, and the surface weather observations were turned over to the Bureau of Air Commerce personnel. The consolidation made it possible for the Weather Bureau materially to strengthen its service at the 10 airway forecast centers by providing the personnel and assignment of forecasters for 24-hour daily service. The arrangement permitted the Bureau of Air Commerce to extend its network of communications to other airways over which service had not been provided. The meteorological and communication services at important airports are now on a practicable and efficient basis, and duplication of effort has been eliminated.

### THE VALUE OF FOUR MAPS A DAY IN THE AIRWAY SERVICE

For a number of years the Weather Bureau has recognized the need of improving the general weather service by the issuance of four maps a day. The cost, although relatively not large, has prevented the inauguration of the service because of the limited funds available. The framework for such a service was laid during the past year through reorganization of service for airways. The consolidation of meteorological and communication activities with the elimination of the airway sectional maps, which covered 4-hour periods, and their transmission as such by teletype, made this beginning possible. Some of the savings in funds which resulted from the reorganization were used in providing a few additional reports, and with increased time available on Bureau of Air Commerce teletype circuits, more complete meteorological data were transmitted for the preparation and analysis of Nation-wide maps at airport stations, covering a 6-hour period.

The 8 a. m. and 8 p. m. maps, prepared at airport stations from the regular collection of Weather Bureau signals, cover an area from Honolulu to Bermuda and from northern Alaska to southern Mexico. The 2 a. m. and 2 p. m. maps are prepared from selected airway sequence reports and off-airway station reports which cover the entire United States.

Weather maps on a 6-hour basis can be used more advantageously than on any other time basis. Many years ago it was recognized by meteorologists that the time interval between weather maps should be equal and that the basic observations should be taken at the same time at all stations day after day. This was the basis for the original establishment of 8 a. m. and 8 p. m., eastern standard time, observations and weather maps.

It was recognized from the beginning that more frequent maps were needed for the intensive service which aviation demanded. In 1929 the sectional 3-hour weather maps were inaugurated, but it was apparent that the area covered by these maps was not as extensive as it should be. A change was made in 1932 to 4-hourly airway sectional maps covering increased area. These also were too limited and had a further disadvantage in that the period was an odd multiple of the 12-hour basic period. The recent change to 6-hour maps reduced the disadvantages heretofore experienced. Moreover the 6-hour maps coincide in time with the maps prepared by a number of foreign meteorological services and will later permit the exchange of reports with other countries when funds are provided for placing the general weather service of the Bureau on a 6-hour basis.

This service for airways was inaugurated on May 1, 1935. Forecasts are issued four times a day covering a period of 8 hours in advance. When conditions warrant, special forecasts are issued between the 6-hour periods, based on 3-hour intermediate sectional maps which are prepared from the network of airway reports. The present plan is the most efficient yet devised and has some distinct meteorological advantages which no other timed system possesses.

### UNIFORM PROCEDURE IN PREPARING MANUSCRIPT MAPS

On March 1, 1935, standardized procedures for drawing manuscript maps at all Weather Bureau offices and airport stations were put into effect. Uniformity in the use of symbols and other entries on maps and in drawing

isograms is secured by this standardization, which is valuable for many reasons, but chiefly to aviators and others who have occasion to examine maps at different offices of the Bureau and also for the Bureau's own employees who are transferred from one field station to another. The symbols adopted by the Bureau were made to conform as nearly as practicable to international usage.

## REORGANIZATION OF THE HURRICANE-WARNING SERVICE

For many years prior to July 1, 1935, the hurricane-warning service of the Weather Bureau was centered at Washington. Radio weather reports from ships in the areas frequented by hurricanes and meteorological observations from island and coastal stations in those areas were collected at Washington only. The reports were charted and advisory and warning messages were distributed from the Washington center for the benefit of shipping and residents of island and coastal communities. This is one of the most important services of the Bureau. It has been instrumental in saving many human lives and millions of dollars' worth of property.

Owing to the cost of repeating the observations to Weather Bureau offices on the South Atlantic and Gulf coasts, it was necessary to confine the information provided those offices for public service to 2 or 3 daily telegrams containing brief statements as to the location, intensity, and probable movement of the storm with notification of such warnings as were indicated by the reports collected. Personnel and facilities were inadequate for a continuous operation of the service for 24 hours each day. There was a hiatus between the daily 8 p. m., eastern standard time collection of reports and the collection 12 hours later. During this 12-hour period tropical storms sometimes progressed rapidly, which made it difficult in some instances to collect observations at a center far removed from the storm zone and to distribute timely warnings to the threatened areas.

Funds in the amount of \$80,000 were provided the Weather Bureau in the agricultural appropriation bill for reorganization and extension of the hurricane-warning service. Plans for the new form of service were prepared so that promptly on July 1, 1935, a special teletype system was set up by the Bureau to connect 10 stations on the coast with the new hurricane-forecast centers at Jacksonville, Fla., and New Orleans, La. Daily collection of land-station reports and observations by radio from ships in the region frequented by hurricanes will be transmitted over this teletype circuit. When tropical storms are in progress, additional observations at 6-hour intervals or oftener, if necessary, will be furnished to the teletype system with personnel on duty continuously 24 hours each day. This system enables the two forecast centers to receive reports and issue warnings with the dispatch that is possible only with direct communication service operated exclusively for that purpose. A superior information and warning service in connection with hurricanes is now available to the public in the areas served by Weather Bureau offices in the coastal sections of the South Atlantic and Gulf States.

Another hurricane forecast center will be located at San Juan, P. R. The areas to be served by the three centers are:

San Juan: Caribbean Sea and islands east of longitude 75° W. and south of latitude 20° N.

New Orleans: That portion of the Gulf of Mexico and its coast west of longitude 85° W.

Jacksonville: Remaining portions of the Atlantic coast, Caribbean Sea, and Gulf of Mexico areas, and islands and coasts south of latitude 35° N.

Warnings for the Atlantic coast north of latitude 35° N. will continue to be issued from Washington.

Incidental to the hurricane-warning-service reorganization, a new forecast center has been established at Jacksonville for North Carolina, South Carolina, Georgia, and Florida (except the extreme northwest portion) and ocean areas contiguous thereto.

## POSSIBLE REFINEMENT OF FLOOD FORECASTING THROUGH THE USE OF RECORDING INSTRUMENTS

A flood is produced naturally in a primary drainage basin by the continued falling of rain or melting of snow at a rate greater than the maximum rate at which water can be discharged from the basin. In the United States a flood



caused by snow alone is rare, and the forecasting of floods caused by rain falling on a snow mantle cannot be reduced to a formula. This discussion, therefore, will be confined to those floods caused solely by rain, and will be applicable only to primary basins in which the short time between the fall of heavy rain and the occurrence of the resulting flood makes it necessary to base forecasts more on rainfall data than on upstream river gage readings.

The season of the year, the preceding weather, and the drainage basin's topography, geology, and vegetal mantle are essential factors that must be considered in flood forecasting. Assuming that these data are all available and have been given proper places and weights in a formula, there still remains to be obtained the most important factor of all, namely, the hourly amounts of rainfall. This is not available in a complete form under the present system. The total amount and the approximate period in which the rain fell are readily obtained. The forecaster knows, for instance, that 2 inches fell in less than 12 or 18 hours, but he does not know that 80 percent of it fell in 2 hours, and that light showers occurred during the remainder of the period. This is a handicap, but in spite of it valuable flood forecasts are being made and are the means of saving human lives and property. Frequently these forecasts do not give the exact height of the crest and the hour of its occurrence, but they are sufficiently definite to enable the inhabitants of the threatened area to take the precautions necessary to protect their lives and property. The forecaster knows, however, that, given hourly amounts of rainfall for coordination with the continuous records of river stages now being made available through the recent cooperative and constructive work of the Weather Bureau and the Geological Survey, he could evolve formulas that would enable him materially to refine his flood forecasts. He could predict with considerable assurance and definiteness both the height and the time of the flood's crest, instead of expressing his forecasts in rather general language.

Continuous records of river stages are being obtained from recording stations constructed in the last 2 years with funds allotted by the Public Works Administration, and a similar advance in strengthening the method of measuring rainfall would not only make possible the refinement of flood forecasts in primary drainage basins but would also be of inestimable value in agriculture, soil conservation, and all branches of hydraulic engineering. The needs of the flood forecaster alone seem not to have had enough weight to bring about the installation of the required number of recording rain gages, but in the last few years other users of rainfall data have, individually and through their various organizations, been making insistent demands and endeavoring to provide means for the establishment of a network of these gages. The Weather Bureau, therefore, is hopeful that in the near future its flood forecasters may have available enough additional rainfall information to enable them to give to the residents of a threatened valley the exact height and time of arrival of a coming flood.

### SOME RESULTS OF WORK IN MARINE METEOROLOGY

Further noteworthy improvement in accuracy of ships' meteorological instruments and reports was brought about during the year as a result of a program for critical review of mail returns, attended by numerous inspections and tests of instruments. In many cases shipping companies generously provided replacements for instruments found inaccurate, and the faithful efforts of ships' officers observing and reporting weather at sea were thereby made more effective.

Special research was pursued during the year along two lines. Files of ocean-weather observations were in part reexamined from the point of view of the needs of overseas aviation. Water-temperature investigations were continued and broadened.

All available data for an immense area in the tropical Pacific were intensively studied, and definite advances in our knowledge of the climate and meteorology of this hitherto obscure ocean region were obtained. The knowledge will bear upon prospective development of trans-Pacific air routes to the Philippines and Australia. Much work in this field remains to be done.

In water-temperature research special attention was devoted to testing the hypothesis, held in some quarters, that the variations in sea-surface temperatures along the Gulf Stream and at its origins in the Caribbean Sea can be made a practical basis for forecasting the weather of succeeding months over the eastern part of the United States. Mathematical correlation methods rigorously applied to this problem have so far brought mostly negative conclusions.

However, these studies are gradually laying a foundation for approach to the question whether, over longer periods of time running to several years or more



in length, there may not be found cycles of sea-surface temperature variation of relatively small size but perhaps important as an influence upon some of the long-term aspects of our weather history, such as the drought of 1934. This is an ultimate objective of the water-temperature researches, which are being continued.

### THE FIRE-WEATHER SERVICE

The fire-weather service, to which previous reference has been made, is one of the relatively small, but highly important activities of the Weather Bureau. It is conducted as an aid to fire-protection forces in the forestry services of the country. The problem of controlling forest fires is a difficult one involving heavy expenditure of time and money and at times requiring the services of large forces of men. The efficiency of fire control is largely dependent upon forestry officials being prepared for emergencies as they arise in proportion to the seriousness of the fire hazard. Since weather, more than any other factor, is responsible for the degree of fire hazard, forecasts covering those weather elements of direct bearing upon the fire-control problem are invaluable to the protection forces.

The fire-weather forecasting service was first offered to forestry interests in the States on the Pacific coast. It received such a favorable response that it has since been extended to forested areas under protection in other sections of the country. At present, forecasts are provided during periods of fire hazard to Government, State, and private forestry agencies in California, Oregon, Washington, Idaho, Montana, Minnesota, Wisconsin, Michigan, the Adirondacks, the New England States, and the southern Appalachians.

The plan of operation is essentially the same in all fire-weather districts. Meteorological substations are maintained at numerous places within the forested areas, and reports from these stations are transmitted daily by telephone or telegraph during the seasons of hazard to the headquarters of the forecaster for each district, seven in number. These reports, in conjunction with the general weather map, are used as a basis for the formulation of specialized forecasts which are telegraphed or telephoned to fire-control officers of the district, or else are broadcast by radio on exact schedules.

In the California district there is an additional and special method of operation conducted in cooperation with the United States Forest Service. An automobile truck, fitted with office, meteorological and radio equipment capable of sending and receiving messages, is utilized. This truck unit, accompanied by a forecaster and a radio operator, virtually comprising a forecasting office on wheels, proceeds to every large forest fire. Observations are received by radio, and forecasts and advices are issued to those in charge of the fire-fighting crews on the ground. This arrangement offers distinct advantages over the method employed in other districts in that the forecaster becomes an integral and active part of the protective system, issuing minutely localized and adapted warnings and advices for immediate use. Operation of this mobile unit has been so successful that its use in other districts is urged.

In addition to the forecasting work, each fire-weather forecaster cooperates with forestry agencies in the conduct of research work leading to the improvement of forecasts and contributing to knowledge of the relationship between weather conditions and the various degrees of fire hazard.





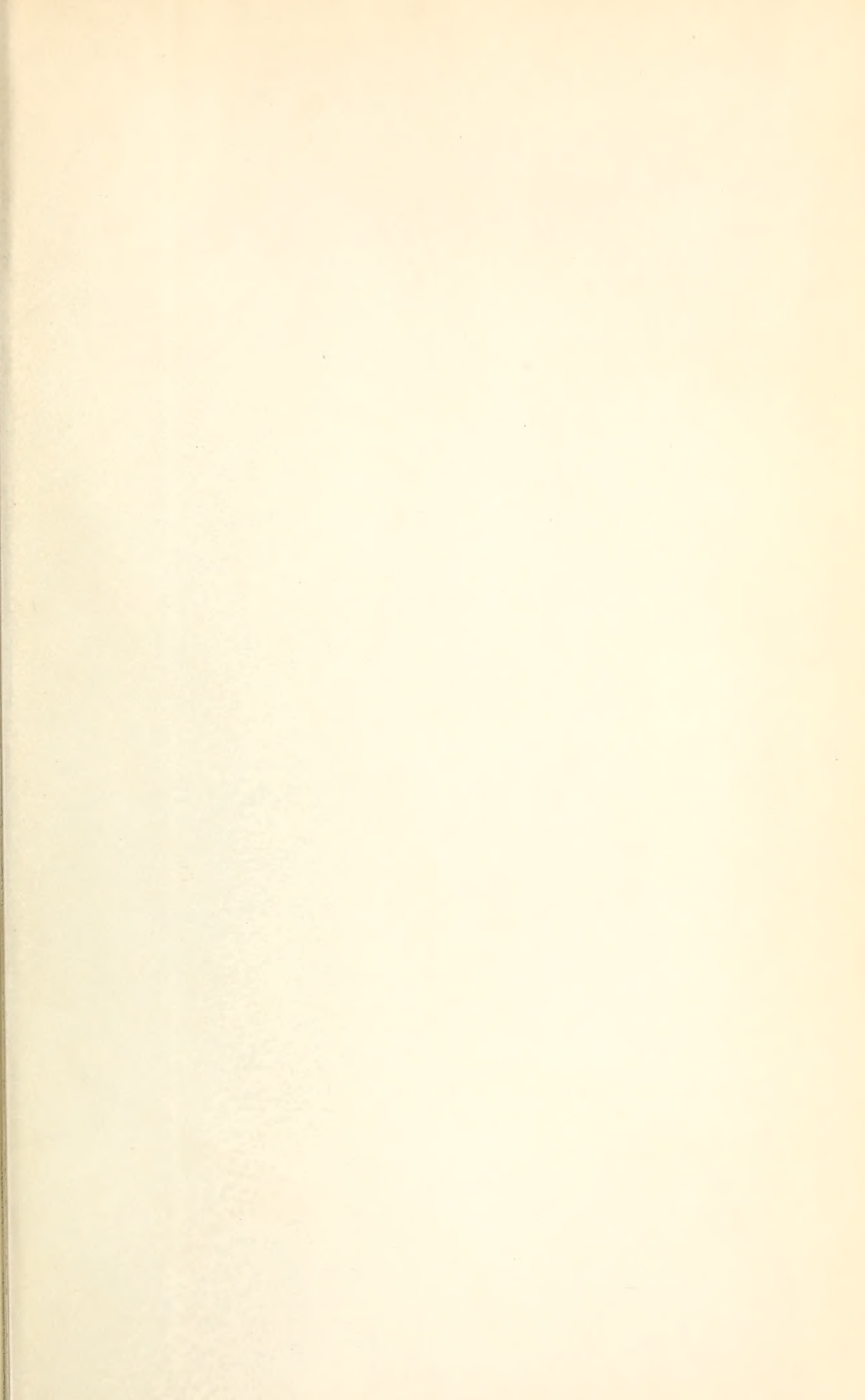


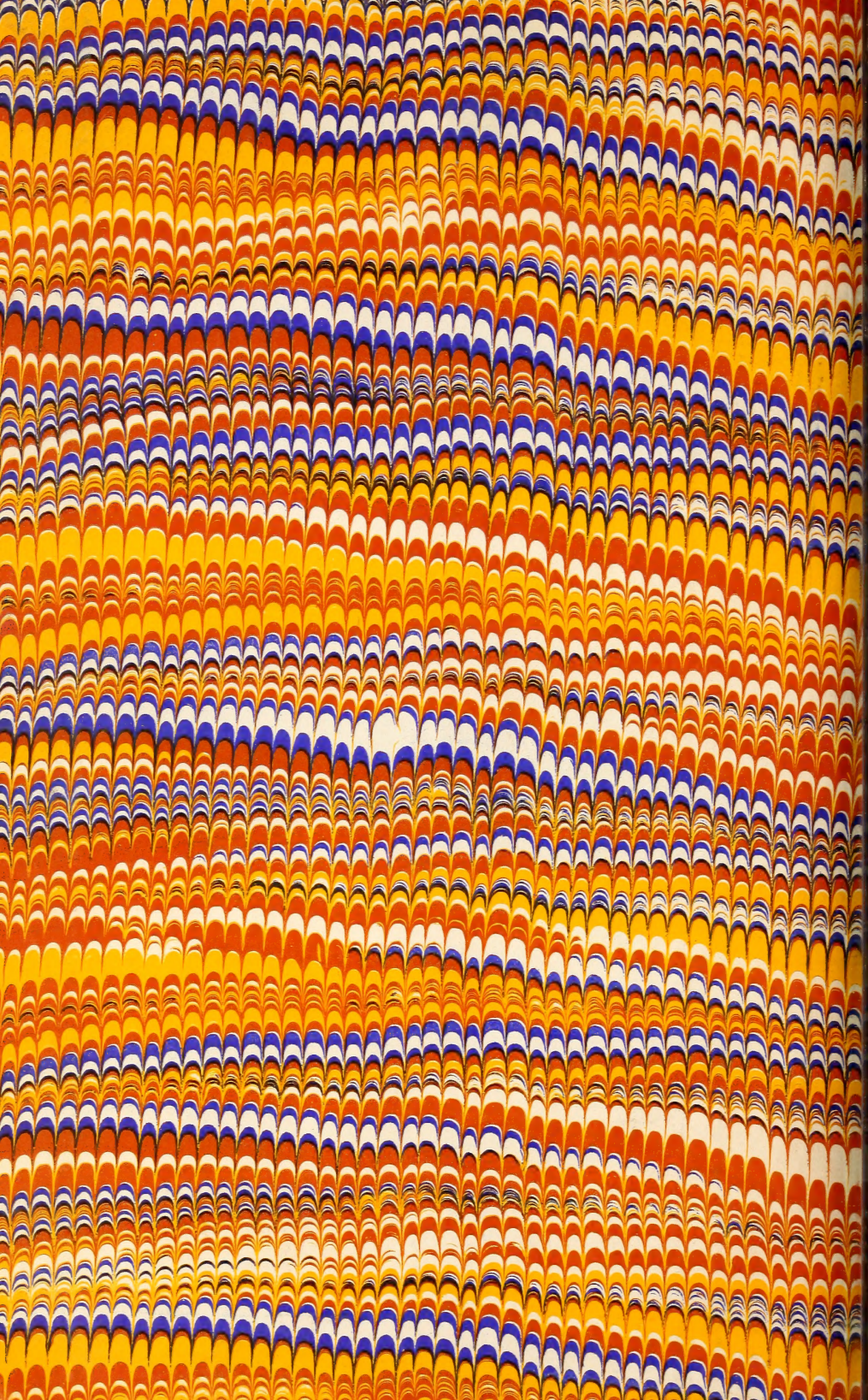




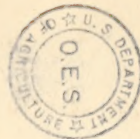












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